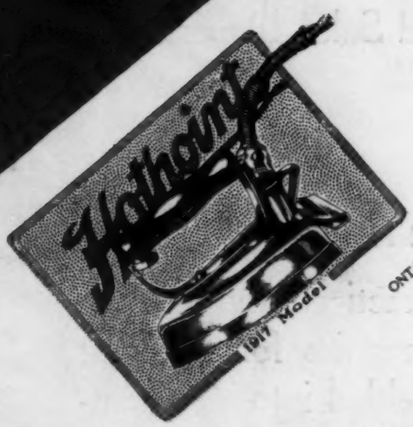
*Devoted to the Generation, Distribution and Utilization of Energy*

# JOURNAL OF ELECTRICITY

VOL. XXXVIII NO. 7 SAN FRANCISCO, APRIL 1, 1917 PER COPY, 25 CENTS


## Two Radical Hotpoint Improvements




HOTPOINT HINGED PLUG CORD PROTECTOR
(Pat. Appl'd for)
This hinge joint and double spiral spring give necessary flexibility and protect cord from excessive bending. Plug easily removed.

ONTARIO, CAL. March 14, 1917.

Dear Sir:

Hotpoint's first month's business was $36.00.

That was thirteen years ago - when we began making electric irons (the few then on the market were very unsatisfactory). It was tough sledding, but WE DEVELOPED THE DETACHABLE SWITCH PLUG, ATTACHED STAND AND eye SHAPED HEATING ELEMENT, PUTTING MOST HEAT IN THE POINT, and orders began to come.

From this feeble start, with one man and a boy, the Company has grown until now it markets annually from its four plants, more electrically heated appliances than any other manufacturer. HOTPOINT IRON SUPREMACY IS AN ESTABLISHED FACT. Quality, workmanship, durability and service, have made Hotpoint appliances preeminent.

But no appliance is perfect. Numerous tests showed the Hotpoint cord connection more durable than the nearest competitor, yet we were not satisfied. There were cord breakage complaints.

THE CAUSE OF THESE COMPLAINTS HAS BEEN BANISHED by a development most sweeping in character- THE HOTPOINT HINGED PLUG CORD PROTECTOR. This plug, illustrated on the enclosed press proof, together with our well-known plug bar and a new spiral spring arrangement PRACTICALLY ELIMINATES TROUBLESOME CORD BREAKAGE.

That every manufacturer has been striving for has been accomplished by Hotpoint ingenuity and we feel justifiable pride in offering you the Hotpoint Iron with this new plug AND THE THUMB REST WHICH MAKES IRONING EASIER.

It is difficult to overestimate the value and importance of these exclusive Hotpoint developments. They will be extensively advertised in National magazines and trade publications. We urge you to order a sample iron complete with new plug and thumb rest, and prepare stock to meet the demand this publicity will create.

HOTPOINT ELECTRIC HEATING COMPANY
Vice President.

PHB-MLP

Evolution of the Hotpoint Iron

1904

1905

1907

1908

1909

HOTPOINT THUMB REST
(Pat. Appl'd for)
Provides natural resting place for thumb; rests the wrist and makes ironing easier. Easier to guide the iron.

Hotpoint Electric Heating Co.,
Ontario, Cal.

Gentlemen:
Please furnish details regarding the new Hotpoint Improvements and Selling Helps.

TEAR OFF THE COUPON AND MAIL TO US

Name .....

Address .....

# Announcement...

## Federal Load Building Service

comprises carefully developed and practicable plans for cooperating with New Business and Sales Departments of Central Stations to develop

1. Electric range load
2. Lamp socket appliance load
3. Electric sign load
4. Window, show case and flood lighting load

These plans have been actually practiced by us with representative Western power companies for the past two years and have recently been welded into one comprehensive load-building service. This service is now available for California, Arizona, New Mexico, Nevada and Oregon, and will shortly be expanded to cover additional Western territory.

These plans embody features as follows:

1. Sale of load-building devices by expert trained salesmen
2. Carrying of term payments by Federal Company
3. Expense proportionate with result—"Measured Service"
4. Minimum outlay per kilowatt of connected load
5. Not limited to sale of goods of any one manufacturer

***Send for explanatory booklet, "Load Building for Central Stations"***

FEDERAL ELECTRIC COMPANY
FEDERAL SIGN SYSTEM (ELECTRIC)
618 Mission St., San Francisco, Cal.

331 Oak Street,
Portland, Ore.

506 Pacific Block Bldg.,
Seattle, Wash.

APR -5 1917

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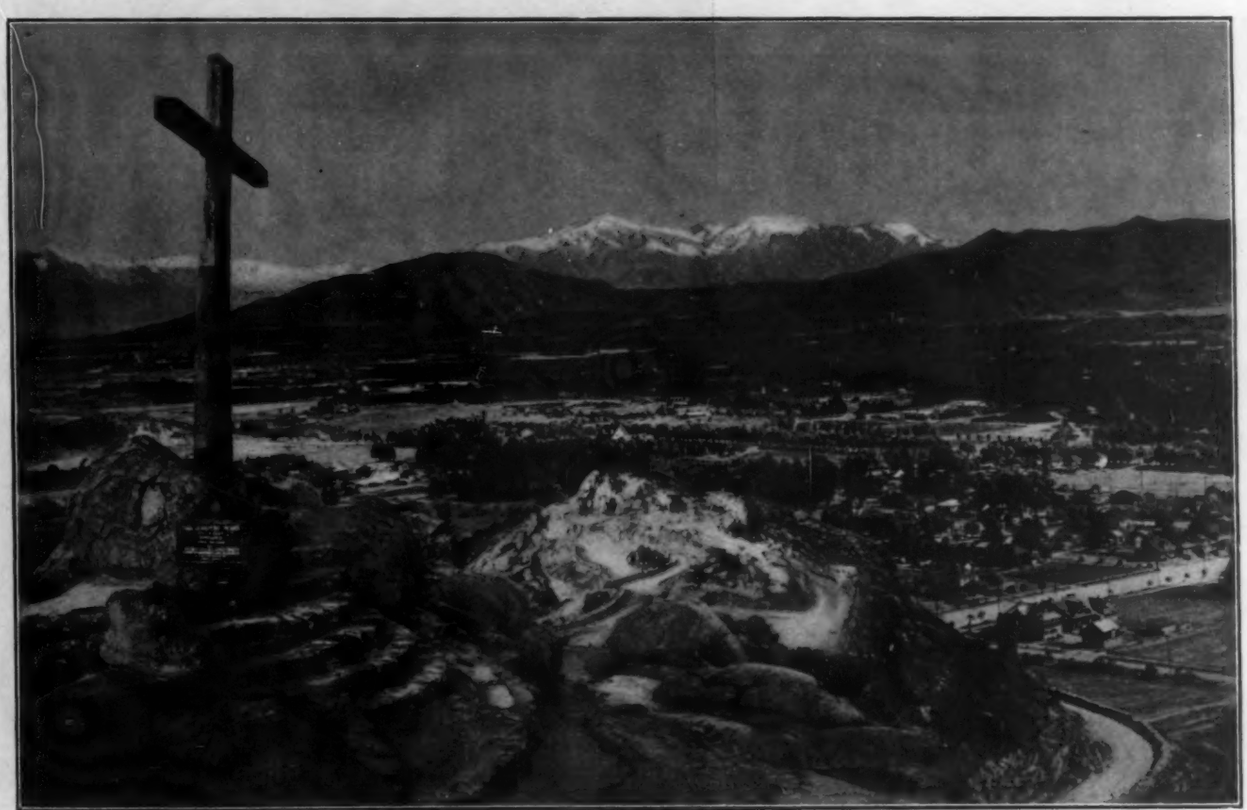
# RIVERSIDE—AN INSPIRATION FOR ELECTRICAL MEN

*(The charm of Western daring and tradition pervades the very atmosphere at Riverside, where is soon to gather an unprecedented number of men of the electrical industry in the West. Riverside, the home of the Glenwood Inn, renowned for its beauty and comfort of setting and the center of the Southern Sierras Power Company, with its six hundred and fifty-four miles of pulsating energy, stretching from Wonder, Nevada, through eastern California to Yuma, Arizona, presents an atmosphere in full keeping for the convention gathering of the Pacific Coast Section of the National Electric Light Association, April 19, 20, 21, 1917. There are times when pictures portray more than words can possibly describe. In issues of the Journal of July 5, 1913, July 12, 1913, November 25, 1916, and December 23, 1916, the various accomplishments and installations of the Southern Sierras Power Company have been fully described. In the following pages may be found a story in pictures that sets forth the wonders of Riverside and the achievements of this remarkable company as they will be explained to guests and visiting members at the convention.—The Editor.)*



**THE STRIKING OUTLOOK FROM RUBIDOUX HILL**

**Here is a scene with its rugged contour in the foreground, with its citrus fruits displayed in all directions, and with its crown of snow-capped mountains in the distance that almost overcomes the onlooker in contemplating the wonders that "God hath wrought" in the creation of an empire so vast, so impressive in configuration, and so abounding in possibility for the work of man, equipped with the all-conquering force—that wonder of modern accomplishment—electricity.**

**THE GLENWOOD INN**

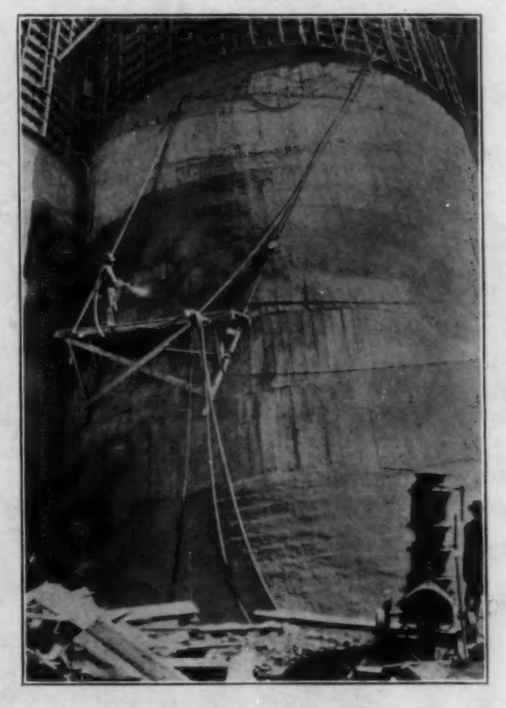
**In full keeping with traditions of the Spanish main and early California romance, this monument of hospitality will greet with open doors the guests and members of the approaching convention.**

**HOME COMFORT AT THE GLENWOOD**

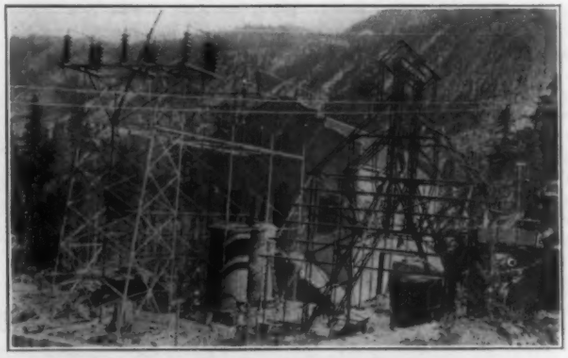
**The wives, sweethearts, daughters and friends of convention members will find every want provided for in these luxurious apartments.**

**THE GEM LAKE DAM OF THE RUSH CREEK DEVELOPMENT**

**In these snow-clad mountains the water wheels of the Southern Sierras Power Company start the pulsating electrical energy on its world-beating distance of transmission of five hundred and thirty miles.**

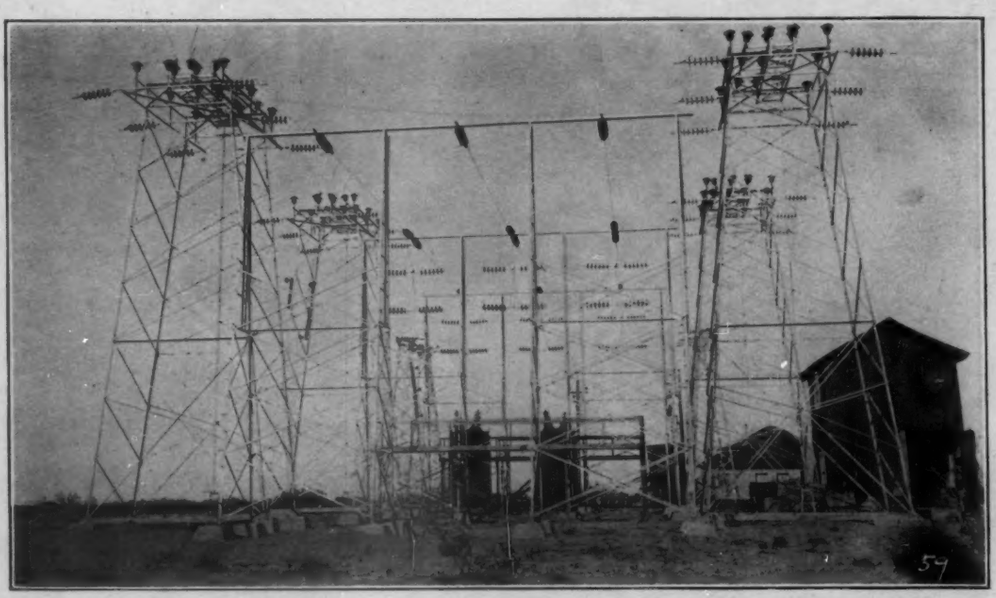


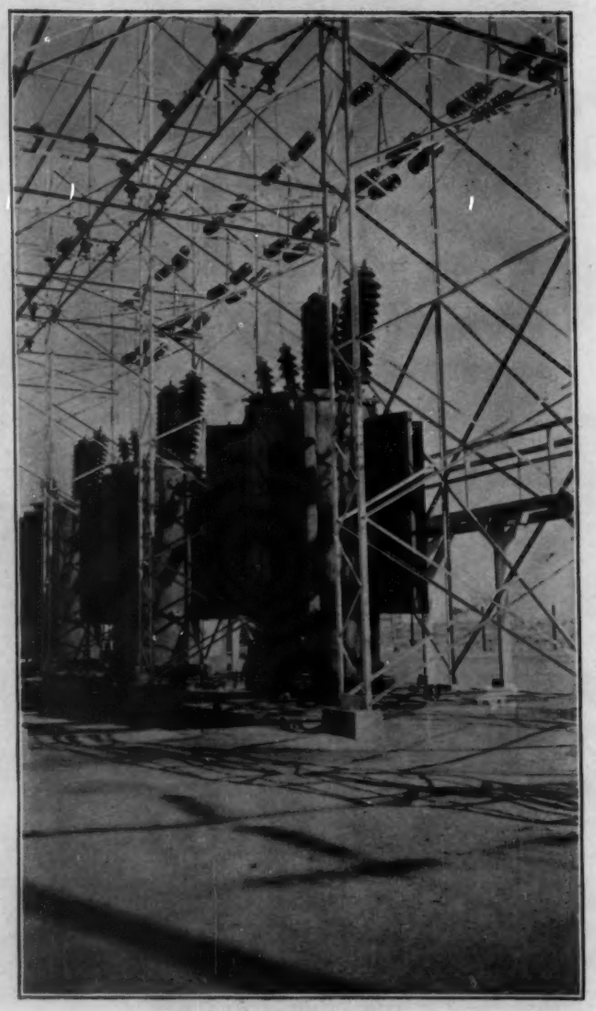
**THE CEMENT GUN**



**HIGH TENSION LINES AND THE MULTIPLE ARCH DAM**

**In the high Sierras the last word in engineering skill and design has been employed to make for efficiency and low cost of production.**





**THE INYO SUBSTATION AND THE NEW RADIATOR TYPE OF TRANSFORMER AT THE VICTORVILLE SUBSTATION**

**The Southern Sierras Power Company is one of the group of associated companies operating in the east and south of California and Western Nevada. These companies obtain their power from Bishop, Rush and Mill Creeks, all of which creeks are on the eastern slopes of the Sierra Nevada Mountains. On each stream are located large reservoirs for equating the flow. There are now in operation seven hydroelectric power lines, all of which are of concrete steel construction, with outdoor type step up transformer stations. Pelton impulse water wheels are used in all plants, on account of the high heads, which vary from 400 to 1900 ft. The combined capacity of all plants is 45,000 kw. As an auxiliary to the hydroelectric plants there is a steam turbine plant located at San Bernardino, which is capable of supplying 8000 kw.**

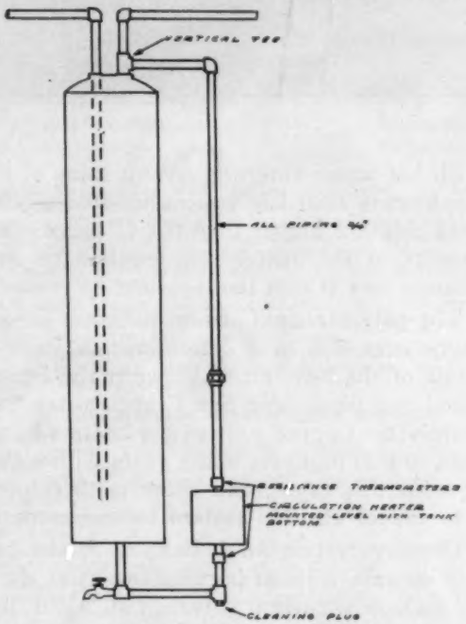
**Connecting San Bernardino and the hydroelectric plant on Bishop Creek is a steel tower line 238 miles long, carrying two 3-phase circuits, the cable used being composed of 6 strands of aluminum with a center strand of steel. All main transmission substations are of the outdoor type. The total mileage of transmission line is 975 miles, connecting to which are 858 miles of distribution lines. The distance from Wonder, Nevada through Bodie to Bishop to San Bernardino to El Centro and ending at Yuma is 654 miles, and from the generating plant on Rush Creek to the end of the transmission line at Yuma, a distance of 530 miles, the greatest distance ever attempted in the history of electrical engineering.**

# EXHAUSTIVE TESTS ON ELECTRIC WATER HEATERS

BY STANLEY V. WALTON

*(Heating water by electricity has received an immense impetus due to its importance and value in connection with the electric range. Exact data concerning performance tests upon various types of electric water heaters have long been lacking. Here is an article on this subject containing a summary of tests on electric water heaters that have recently been made in the testing laboratory of the Pacific Gas & Electric Company. The Commercial Committee of the Pacific Coast Section of the N. E. L. A. has prepared this paper for consideration at the Riverside Convention, April 19, 20, 21.—The Editor.)*

In the following pages are summarized reports of tests made on electric water heaters and on heat losses from boilers and water pipes, bare and insulated. Every effort has been made to condense as much as possible and to include only such descriptive and explanatory matter as will make the report intelligible




Standard Connections for Testing Circulation Type of Water Heaters

For further information, reference must be made to the original detailed reports.

In testing circulation type heaters the method employed was that given in the 1916 report of the N. E. L. A. Electric Range Committee, under the heading, "Standard Test for Electric Water Heaters." As a large portion of this reports covers the circulation heater and as a statement of connections and test method is necessary in order that the report may be made intelligible, they are here explained in detail.

## Standard Test for Electric Water Heaters, Circulation Type

**Purpose.**—The object is to obtain comparative data on electric water heaters that will be independent of external influences, such as the size of boiler and piping, use or absence of thermal insulation, location of heater and surrounding temperature.

**Connection.**—All circulation type heaters were connected for test as shown in the above illustration, entitled "Standard Connection for Testing Circulation Type Water Heaters." The boiler was of nominal 30 gal. size, uninsulated. Piping was ¾ in., except where otherwise specified. Valves in cold and hot water pipes leading to and from the boiler were closed. Electrical resistance thermometers in direct contact with the water were placed close to and on each side of the heater. They were mounted in ¾ in. pipe nipples and consisted of copper coils wound on brass tubing.

**Routine of Test.**—The following data were obtained:

1. Power input on alternating current, hot and cold, at rated voltage.
2. Temperature head and rate of flow.
3. Surface temperature.
4. Losses and efficiency.
5. Insulation resistance, hot and cold.
6. Galvanic e.m.f.
7. Dry test for durability.

### Remarks

1. Due to an appreciable temperature coefficient, of the resistance wire, the power input when cold and hot water respectively is entering the heater, is not the same for all makes of heater tested, but no important variation was discovered.

2. By temperature head is meant the temperature difference between incoming and outgoing water. The temperature head and rate of flow are dependent in every case upon kilowatt capacity of heater and resistance of heater passages and connections. In these tests the numerical values apply only to this particular installation, but are believed to give a reasonable idea of what to expect under similar conditions. They emphasize the necessity, borne out by practical experience, of throttling the circulation passage in order to introduce water at the top of the boiler at a sufficiently high temperature.

Rate of flow is calculated from the temperature head, kilowatt input to heater and heater efficiency as follows:

Let $T$ = temperature head in degs., Centigrade.
$W$ = kilowatt input to heater.
$E$ = heater efficiency.
$V$ = rate of flow in gallons per hour.

$$\text{Then } V = \frac{227.3\ W\ E}{T}$$

3. By surface temperature is meant the external temperature of heater as furnished by the manufacturer, ready for connection. If a lagged heater is supplied, the temperature will be that at the outside surface of the insulation. In these tests it was determined by an electrical contact pyrometer. Surface temperature determines the radiation loss and is of further importance to those who may come in contact with the heater when in use.

General Electric Good Housekeeping Curan

4. Losses occur only by radiation, by air convection currents and by conduction along piping with subsequent radiation. These losses are approximately determined, if, with heater disconnected and water passages plugged, energy is applied at a rate that will maintain the same average surface temperature as found on test. The input to water and corresponding efficiency are found by subtracting the losses from the total input to heater.

5. In these tests efficiency was found in this manner. In stating the efficiency of any heater it is necessary to specify also the corresponding temperature of boiler water, because with cold water entering the heater all temperatures and losses will be lower than with hot water entering. With some of the low capacity heaters tested it was impossible to obtain a boiler temperature higher than 60° C. because the entire capacity of the heater was required to maintain the radiation loss at that temperature.

6. The galvanic e.m.f., as an indicator of possible electrolytic corrosion, was determined between different metals of the heater and between the heater and galvanized iron pipe, using San Francisco tap water as the electrolyte. Copper coils of gas heaters have been connected to iron pipes for many years without serious trouble from this cause, and there is therefore little reason to expect electric heaters to suffer therefrom.

7. The dry test is an indication of the heater's ability to operate without burning out after the deposition of scale or if current is turned on when the tank has been drained of water. This test was made only on heaters of rugged construction, as experience has demonstrated that others, paricularly with bayonet type elements, will burn out when coated with scale.

The tests reported herein were made in the laboratory of the Pacific Gas & Electric Company during 1915 and 1916 under the auspices of the Water Heating Committee of the 1916 Electric Range Committee of the National Electric Light Association.

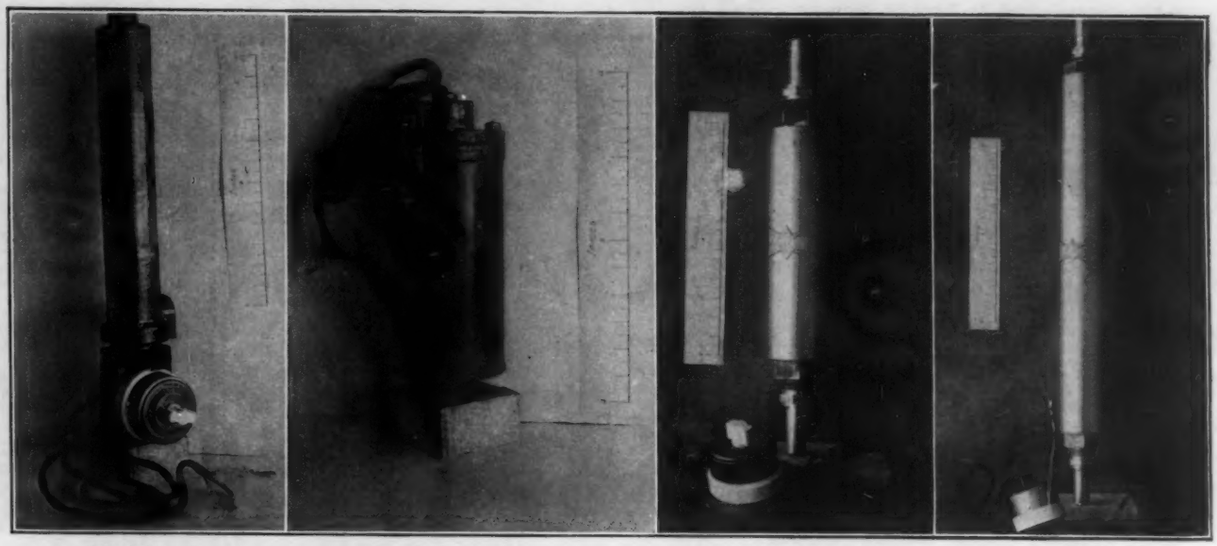
The Coin Machine Company Heater

**General Electric Company**

**Date Tested**—August 29, 1916.
**Type**—L-59, Circulation. Non-automatic.
**Volts**—110.
**Watts**—700.
**Heat**—Single.
**Overall Dimensions**—3½ in. by 2¾ in. by 16 in.
**Weight**—4.75 lb.
**Construction**—Copper tube wound with metal sheathed nichrome wire encased in a cast aluminum jacket. Heat flow is radially inward to water and outward to air.
**Insulation**—None.
**Facilities for Cleaning**—Excellent; see photo. By removing plugs at either end heater can readily be cleaned without disconnecting.

Test

**Connections and Method**—Standard.
**Temperature Head**—12° C. at start; 8.5° C. after 6 hours.
**Circulation**—12.2 gal. per hr. at start; 14.2 gal. per hr. after 6 hrs.
**Losses**—43 watts at start; 114 watts after 46 hrs.
**Efficiency**—94% at start; 82% after 46 hrs.
**Watts Input**—At constant voltage of 110 applied the input decreased from 725 to 685 watts in the first hour with cold water in the boiler and then slowly dropped to 645 watts after 46 hours.
**Insulation Resistance**—Cold = 1000 megohms; hot = 76megohms.
**Galvanic E.M.F.**—.4 volt, copper tube to galv. iron pipe.



Hughes Style 84 | Hughes Style 81 | Simplex Type T-426 | Simplex Type T-422

**Durability**—The heater was disconnected from the boiler and connected directly across a line e.m.f. of 120 volts. It assumed a dull red heat after about 10 minutes and remained at this temperature with current on for approximately an hour. Upon cooling to room temperature the heater showed no signs of deterioration and the resistance was the same as before the test.

**Remarks**—This heater has an unusually low efficiency, due apparently to the use of a fine resistance wire which is forced to operate at too high a temperature.

The bimetallic construction of an aluminum jacket cast around a copper tube has been abandoned in favor of a single homogeneous casting.

### Coin Machine Manufacturing Company

**Date Tested**—January 21, 1916.
**Type**—Induction. Two heaters, No. 35B-109 S. C., No. 35A-55.
**Volts**—110.
**Amperes**—11 and 8.5. 1000 and 750 watt nominal.
**Heat**—Single.
**Overall Dimensions**—9 in. by 7.75 in. by 6.25 in.
**Weight**—26 lb.

**Construction**—A structure consisting of a copper coil with hollow core of cast iron or steel and laminated iron yokes, arranged somewhat in the order of a shell type transformer. When the coil is connected to the proper alternating current supply, eddy currents are set up in the core, which will heat water in contact therewith. The coil is wound with asbestos insulated wire, and is protected by an external cast iron shell. Water comes in direct contact with heating element. Heat flow is radially inward to water and outward to air along good conducting paths of metal.

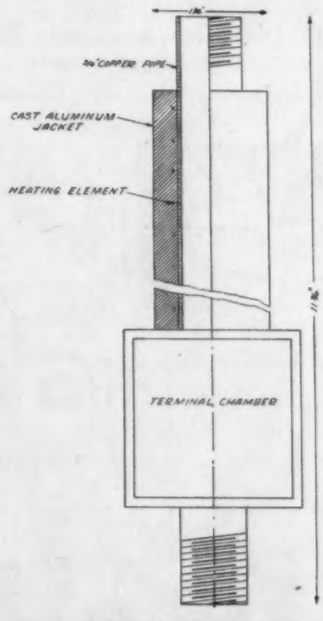
**Insulation**—None.
**Facilities for Cleaning**—None, unless piped with special tees. Otherwise heater must be disconnected.

Test

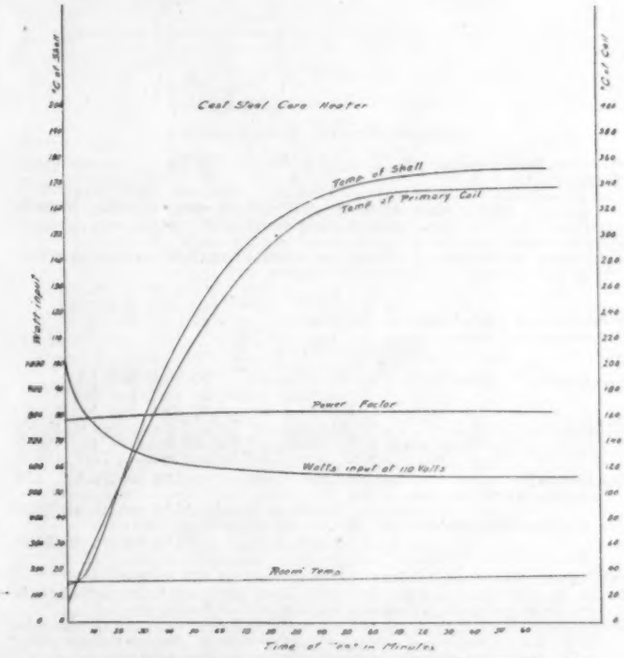
**Connections and Method**—Standard, ½ in. circulating pipe.
**Temperature Head**—17° C.
**Circulation**—13 gal. per hr.
**Efficiency**—750 watt heater, 96% decreasing to 88% after 12 hrs.
1000 watt heater, 97% decreasing to 90% after 12 hrs.
**Watts Input**—At 110 volts, 750 watt heater, 740 to 700 watts after 12 hrs.
1000 watt heater, 1050 to 900 watts after 12 hrs.
**Power Factor**—At 110 volts, 750 watt heater, 77% to 74% after 12 hrs.
1000 watt heater, 79% to 80.5% after 12 hrs.
**Surface Temperature**—73° C. with water discharging at 64° C.
**Durability**—Heater stood dry test with 150 volts applied for over an hour without injury.
**Remarks**—The induction heater is probably the most durable of any made. Its efficiency can be increased by proper lagging. The low power factor is undesirable. In service it has been found to produce an objectionable hum that is transmitted by the piping to which it is connected.

### Hughes Electric Heating Company

**Date Tested**—August 24, 1916.
**Type**—Style 84, No. 23214. Circulation, non-automatic.
**Volts**—110.
**Amperes**—6.9.
**Heat**—Single.




General Electric Water Heater




Characteristics of Dry Run of Induction Heater No. 35

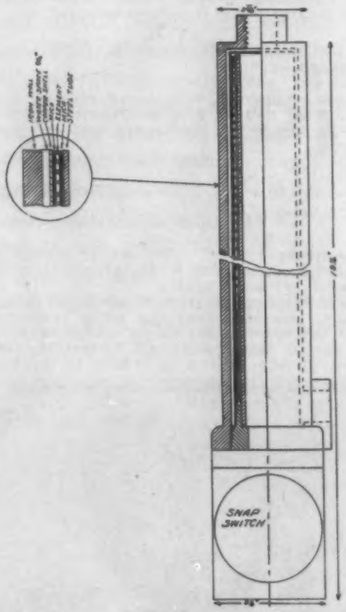
**Overall Dimensions**—10½ in. by 4 in. diameter.
**Weight**—10¼ lb.
**Construction**—Cast iron shell enclosing a cylindrical, bayonet type heating unit, which consists of a layer of resistance wire wound over a mica insulated metal cylinder. Over the resistance wire is placed a second layer of mica and the whole unit is covered with a copper sheath. Surrounding the cast iron shell is a light sheet iron casing, forming with the shell an annular space for placing insulating material. Heat flow is from element outward into water.
**Insulation**—⅛ in. sheet asbestos.
**Facilities for Cleaning**—By unscrewing the bolts shown in picture, the heating element can be removed, without disconnecting heater.

Test

**Connections and Method**—Standard.
**Temperature Head**—12° C. at start; 9.1° C. after 7 hrs.
**Circulation**—13 gal. per hr. at start; 19 gal. per hr. after 8 hrs.
**Losses**—Less than 1% after 24 hrs. with water in boiler at 55° C.
**Efficiency**—99% or better.
**Watts Input**—709 watts at 110 volts, dropping to 705 watts after 24 hrs. at constant voltage.
**Maximum Surface Temperature**—20° C. after 24 hrs. operation, at lower end to which heating element is attached. Room temperature 12° C.
**Insulation Resistance**—Cold = 900 megohms; hot = 2500 megohms.
**Galvanic E.M.F.**—.4 volt between iron shell and copper sheath of heating unit. Calculated current = .033 amps.
**Durability**—Dry test was not attempted because of understanding that heating element would soon be destroyed if current were turned on without water in the heater.

### Hughes Electric Heating Company

**Date Tested**—August 23, 1916.
**Type**—Style 84, No. 23214. Circulation, non-automatic.
**Volts**—110.
**Watts**—500, 1000, 2000.
**Heat**—Three.

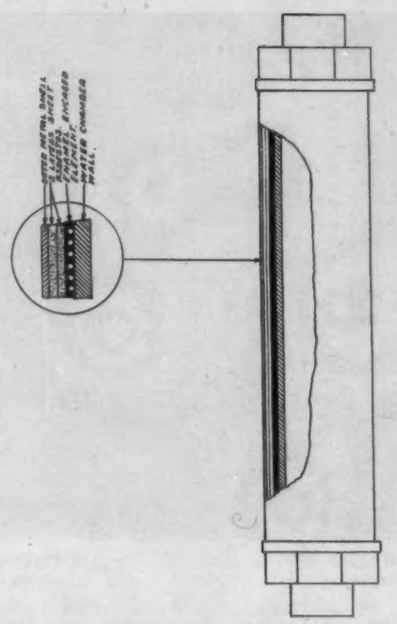



Hughes Electric Water Heater

**Overall Dimensions**—20 in. by 5¾ in. by 3½ in.
**Weight**—12.25 lb.
**Construction**—Bayonet type element inserted into cast iron shell. See accompanying photograph and sectional view. Heat flow is from element outward into water.
**Insulation**—None.
**Facilities for Cleaning**—Heating element may be removed without disconnecting rest of heater.

Test

**Connections and Method**—Standard.
**Temperature Head**—Low heat, 7° C.
Medium heat, 11° C.
High heat, 16° C.
**Circulation** (After 24 hrs.)—Low heat, 16 gal. per hr.
Medium heat, 20 gal. per hr.
High heat, 27 gal. per hr.
**Efficiency**—Low heat, 93% temp. of boiler water 44° C.
Medium heat, 95% temp. of boiler water 59° C.
High heat, 94% temp. of boiler water 120° C.
**Watts Input** at 110 Volts—Low heat, 536 watts to 528 watts after 24 hrs.
Medium heat, 1028 watts to 1007 watts after 24 hrs.
High heat, 2122 watts to 2016 watts after 24 hrs.
**Insulation Resistance**—Insulation failed at 600 volts.
**Galvanic E.M.F.**—.42 volt between iron shell and copper sheath of heating unit. Calculated current .07 ampere.
**Durability**—Dry test was not attempted because of understanding that heating element would soon be destroyed if current were turned on without water in the heater.



The Simplex Electric Water Heater

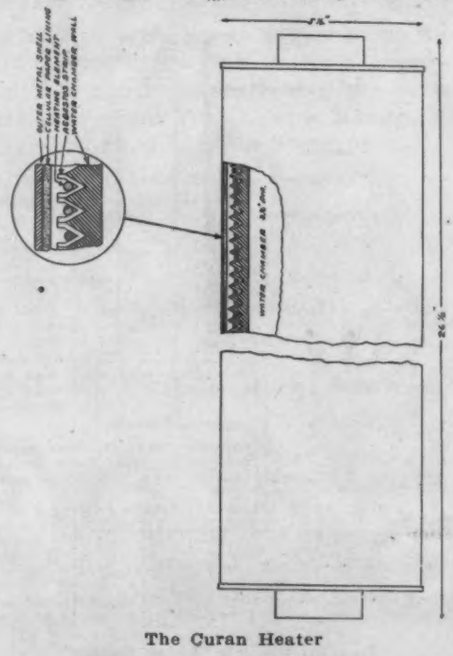
**Remarks**—The design of this heater inherently lends itself to high efficiency.

### Simplex Electric Water Heater

**Date Tested**—August 28, 1916.
**Type**—T-426, No. 820714. Circulation; Non-automatic.
**Volts**—200, 250.
**Amperes**—13.4.
**Heat**—Three, 750, 1500, 3000 watts.
**Overall Dimensions**—32.5 in. by 3 in. diameter.
**Construction**—A brass tube wound on the outside with resistance wire baked on with enamel. Overall is an enclosing, nickel plated, brass shell. The diameter of water passage is 1.5 in., throttled at inlet and outlet to 7/16 in. Heat flow is radially inward to water and outward to the air.
**Insulation**—None.
**Facilities for Cleaning**—None. Heater must be disconnected from boiler or else piped with special tees.

Test

**Connections and Method**—Standard.
**Temperature Head**—Low range, 14° C.
Medium range, 21° C.
High range, 31° C.
**Circulation**—Low range, 12 gal. per hr.
Medium range, 15 gal. per hr.
High range, 20 gal. per hr.
**Efficiency**—Low range, 96% boiler temperature 41° C. Avg.
Medium range, 94% boiler temperature 77° C. Avg.
High range, 96% boiler temperature 93° C. Avg.



The Curan Heater

**Watts Input**—After 24 hours operation at 220 volts—
Low range, 734 watts.
Medium range, 1468 watts.
High range, 2879 watts.

**Maximum Surface Temperature**—Low range, 49° C.
Medium range. 94° C.
High range, 122° C.

Readings were taken at end of 24-hour runs, the heater having assumed in each case its maximum temperature.

**Galvanic E.M.F.**—.9 volt between brass tube and galvanized iron pipe.

**Durability**—Dry test was not made.

### Simplex Electric Water Heater

**Date Tested**—August 26, 1916.
**Type**—T-422, No. 789826 Circulation; Non-automatic.
**Volts**—110, 120.
**Amperes**—6.7.
**Heat**—Three, 150, 500, 700 watts.
**Overall Dimensions**—21.5 in. by 3 in. diameter.
**Weight**—Including three range snap switch = 9.1 lb.
**Construction**—See report on Simplex heater No. 820714 and accompanying drawing.
**Insulation**—Two thin layers of sheet asbestos.
**Facilities for Cleaning**—None. Heater must be disconnected from boiler or else piped with special tees.

#### Test

**Connections and Method**—Standard.
**Temperature Head**—Low range, 6 ° C.
Medium range, 12.5° C.
High range, 15 ° C.
**Circulation**—Low range, 6 gal. per hr.
Medium range, 8.5 gal. per hr.
High range, 10.5 gal. per hr.
**Efficiency**—Low range, 95% boiler temperature 29° C. Avg.
Medium range, 97% boiler temperature 40° C. Avg.
High range, 96% boiler temperature 54° C. Avg.
**Watts Input**—at 110 volts—Low range, 159 watts.
Medium range, 477 watts.
High range, 716 watts.
**Maximum Surface Temperature**—Low range, 31°.
Medium range, 44°.
High range, 59°.
**Insulation Resistance**—34 megohms cold and 360 megohms at operating temperature.
**Galvanic E.M.F.**—.9 volt between brass tube and galvanized iron pipe.
**Durability**—Dry test was not attempted.

### Curan Heater

**Date Tested**—August 18, 1916.
**Type**—Circulation; Non-automatic.
**Volts**—110.
**Amperes**—5.5.
**Heat**—Single.
**Overall Dimensions**—26.5 in. by 5.5 in. diam.
**Weight**—36 lb.
**Construction**—A grooved, cast iron cylinder with resistance wire wound in the groove and separated from the cylinder by asbestos strip. A layer of cellular paper is placed over the resistor with an enclosing sheet iron jacket over all. The diameter of water passage is 4 inches and connections are for 1½ in. pipe. Heat flow is radially inward to water and outward to air.
**Insulation**—Paper.
**Facilities for Cleaning**—None, unless piped with special tees. Otherwise heater must be disconnected.

#### Test

**Connections and Method**—Standard.
**Temperature Head**—15° C. falling to 9.5° C. after 24 hours.
**Circulation**—12 gallons per hour, increasing to 14 g.p.h. after 24 hours.
**Losses**—5 watts increasing to 44 watts after 24 hours.
**Efficiency**—99.5% decreasing to 97.5% after 24 hours.
**Watts Input**—612 watts, decreasing to 588 watts after 24 hours at 110 volts.
**Maximum Surface Temperature**—35° C. at discharge end of heater after 47 hr. run.
**Insulation Resistance**—Insulation failed under 600 volts during test.
**Durability**—Dry test not attempted.
**Remarks**—This heater was designed and built in Spokane, apparently for the purpose of handling water that carries much solid matter in solution, where burnouts due to scale formation have been serious. The low wattage and large surface in contact with water mean low temperature of heating wall, also for a given quantity of water heated, the thickness of scale deposited will vary inversely with the heating surface, so that scale should deposit on this heater in a much thinner layer than on other heaters of smaller dimensions.

In spite of the large radiating surface, high efficiency is secured by low operating temperature of the heating element.

### Good Housekeeping Electric Water Heater

**Date Tested**—August 28, 1916.
**Type**—Style "W," Serial No. 29. Circulation; Automatic.
**Volts**—110.
**Watts**—950.
**Heat**—Single.
**Overall Dimensions**—With cover in place, 5 in. by 8 in. by 20.75 in.
**Weight**—19 lb.
**Construction**—A heavy iron "U" tube contains in one arm a bayonet type heating element and in the other arm a thermostat consisting of an hermetically sealed tube containing a liquid of low boiling point. The vapor from this liquid operates with a strong pressure against a copper diaphragm of the "oil can" type, the motion of which is transmitted to a single pole switch in series with the heating element.

The thermostat can be adjusted to cut the current on and off at any desired temperature.

Connection should be so made that water enters on the thermostat end of the heater.

The "U" tube is enclosed in a rectangular, sheet metal case which is filled with insulating material.

**Insulation**—Granulated cork, to a minimum thickness of about one inch.

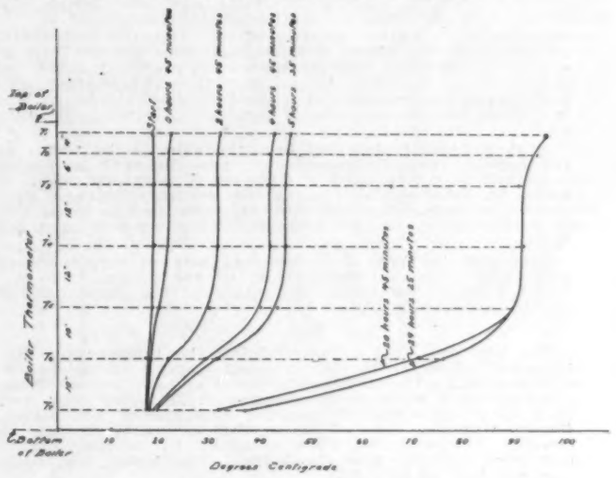
**Facilities for Cleaning**—Thermostat and element can be removed without disconnecting heater. To properly clean the "U" tube, heater should be disconnected from boiler.

#### Test

**Connections and Method**—Standard.
**Temperature Head**—10.5° C. to 9.5° C. after 24 hours.
**Circulation**—20.3 gals. per hr.
**Losses**—About 1.5%. There was an additional loss in the switch contacts of 11.5 watts, or about 1.2%.
**Efficiency**—98.4% exclusive of loss in switch contacts.
97.2% including loss in switch contacts, with water entering boiler at 70° C.
**Watts Input**—957 to 948 watts after 24 hours operation at 110 volts.
**Maximum Surface Temperature**—45° C. with 110 volts applied. This temperature was found on upper surface of heater, adjacent to element and was due to conduction through metal parts.
**Insulation Resistance**—3.6 megohms.
**Galvanic E.M.F.**—.42 volt between iron tube and copper sheath of heating element. Calculated current = .4 ampere.
**Durability**—Dry test not attempted.
**Remarks**—Production of this heater has been abandoned by the manufacturer but test is reported because the development is novel and interesting. The thermostat and switch have shown great reliability and long life in other apparatus when used with currents of not over 5 amperes. For ten amperes and above the carbon contacts have proven too light for continuous service. The insulation resistance of 3.6 megohms is too low for a mica insulated resistor and indicates a defective element. Much trouble was experienced with these heating units due to defect in manufacture.

### Apfel Electric Water Heater

**Date Tested**—October 19, 1916.
**Type**—Immersion; Non-automatic—Serial No. 144.




Apfel Electric Water Heater

**Volts**—110.
**Amperes**—4.8.
**Heat**—Single.
**Overall Dimensions**—4 ft. 6 in. by 1 in. diameter.
**Construction**—The heater consists of a 17 in. spiral of resistance wire wound on an insulating spool and placed in the lower end of an oil filled ¾ in. galvanized iron pipe, 4 ft. 6 in. long. The heater is inserted from the top of the boiler with a threaded connection to screw into one of the standard top openings. When in place the heating element is about 14 in. from the bottom of the boiler.
**Installation**—Boiler must be disconnected and drained. Since heater occupies one of the top openings the cold water pipe must be connected to the bottom of the boiler.

#### Test

As an immersion heater must have a practically 100% efficiency, the test consisted in determining the temperature distribution in an insulated 30 gallon boiler equipped with this heater. The insulation consisted of 1 in. hair felt. No water was drawn off during test. Temperature measurements were obtained by mercury thermometers inserted into boiler at various elevations.

Test results are given on the accompanying curve sheet.

**Durability**—No test was made to determine the durability of this heater although information on this point is highly desirable.
**Remarks**—Results show that in the upper 60% of the boiler mixing is thorough and the temperature is quite uniform. In the lower 40 per cent the temperature falls rapidly so that the net effect is to reduce the available hot water storage by approximately 20%.

**LOG OF TEST, THERM-ELECT HEATER**

**Cold Water Start**

| Date | Time | Hours of Run | Watts | Room Temp | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-23-16 | 11:00 a.m. | 0 | 1400 | 18.3 | 20.3 | 20.3 | 20.3 | 20.2 | 20.0 | 20.0 | 20.2 |
| 8-23-16 | 11:30 a.m. | 30 | 1400 | 19.4 | 25.0 | 24.4 | 24.4 | 25.0 | 24.5 | 24.5 | 23.0 |
| 8-23-16 | 12:30 p.m. | 1-30 | 1400 | 20.0 | 33.0 | 33.0 | 33.1 | 33.5 | 32.0 | 33.2 | 32.0 |
| 8-23-16 | 1:30 p.m. | 2-30 | 1400 | 20.0 | 41.0 | 40.9 | 40.5 | 41.0 | 39.9 | 40.1 | 38.0 |
| 8-23-16 | 2:30 p.m. | 3-30 | 1400 | 20.0 | 50.0 | 50.0 | 49.9 | 50.0 | 49.9 | 49.8 | 51.0 |
| 8-23-16 | 3:30 p.m. | 4-30 | 1400 | 20.2 | 59.0 | 59.0 | 58.0 | 59.5 | 59.9 | 59.9 | 59.8 |
| 8-23-16 | 4:30 p.m. | 5-30 | 1400 | 20.8 | 65.0 | 63.5 | 63.5 | 65.0 | 63.0 | 63.5 | 60.2 |
| 8-24-16 | 8:00 a.m. | 21-0 | 250 | 18.3 | 87.0 | 87.5 | 88.0 | 85.0 | 86.5 | 86.0 | 81.0 |
| 8-24-16 | 11:15 | | 1000 | 20 | 84.1 | 81.9 | 79.8 | 81.5 | 78.9 | 78. | 78. |
| | | | | **5 Gallons Drawn Off** | | | | | | | |
| 8-24-16 | 1:30 | | 1360 | 20.5 | 85 | 87 | 83 | 84.5 | 81 | 61 | 52 |
| 8-24-16 | 2:30 | | 795 | 20.5 | 85 | 84 | 81 | 83 | 80 | 81 | 74.5 |
| 8-24-16 | 3:30 | | 300 | 20 | 88 | 87.5 | 83 | 80.2 | 80.3 | 84 | 81 |
| 8-24-16 | 4:40 | | 300 | 20.8 | 88.5 | 87.6 | 81 | 83 | 84.5 | 84.5 | 83 |
| 8-25-16 | 8:00 | | 150 | 18.5 | 88 | 87.1 | 84.2 | 85.3 | 83 | 84.4 | 81 |
| | | | | **15 Gallons Drawn Off** | | | | | | | |
| 8-25-16 | 8:40 | | 1375 | 18.7 | 86 | 84.9 | 81.1 | 77.2 | 45 | 39.1 | 34.4 |
| 8-25-16 | 9:30 | | 1375 | 19 | 82 | 72 | 81.1 | 49.9 | 50.5 | 59.2 | 41.1 |
| 8-25-16 | 10:30 | | 1375 | 19 | 80 | 78 | 75 | 68 | 67.5 | 66 | 62 |
| 8-25-16 | 12:00 | | 1380 | 20 | 82 | 79.1 | 77 | 80 | 77 | 76.5 | 76 |
| 8-25-16 | 1:20 | | 450 | 20 | 87.5 | 85.5 | 85 | 81.5 | 84.3 | 84.2 | 81 |
| 8-25-16 | 3:00 | | 260 | 20 | 89 | 83 | 84.2 | 85.8 | 83 | 85 | 82.5 |
| 8-25-16 | 4:00 | | 260 | 20 | 89 | 88.5 | 84 | 85.5 | 82.5 | 85 | 82 |
| 8-26-16 | 8:00 | | 450 | 18.5 | 84 | 87 | 85 | 86 | 82.1 | 85 | 82 |
| | | | | **25 Gallons Drawn Off** | | | | | | | |
| 8-26-16 | 8:30 | | 1390 | 18.5 | 82.5 | 79.8 | 59.5 | 42 | 35.1 | 33.5 | 30 |
| 8-26-16 | 9:30 | | 1390 | 19 | 75 | 72 | 45 | 45 | 42.5 | 44 | 41.6 |
| 8-26-16 | 10:30 | | 1395 | 19.1 | 70.5 | 66.5 | 54.5 | 55.1 | 52 | 54.8 | 52.1 |
| 8-26-16 | 11:30 | | 1395 | 20.5 | 61.5 | 65 | 62.5 | 60.5 | 64 | 64 | 62.5 |
| 8-26-16 | 3:15 | | 750 | 19.8 | 87.5 | 85.2 | 83 | 84 | 79 | 84 | 81 |

Thermometers are numbered from the top of the boiler.

### Therm-Elect Water Heater

**Date Tested**—October 2, 1916.
**Type**—Immersion; Automatic. Serial No. 1061.
**Volts**—110.
**Amps.**—13.6.
**Heat**—Six.

**Construction**—The heater consists of an originally flat, metal sheathed element about 20 in. long, rolled into the form of a tube that is not entirely closed, to enable it to be inserted into a one-inch boiler opening. The heating unit is designed for insertion into the bottom of the boiler and is divided into six sections, of nominally 250 watts capacity each.

A thermostat is inserted into the side of the boiler in the opening usually provided in the standard 30 gallon domestic tank. It carries six switch contacts, each of which controls one section of the heating element. Portions of the heating unit are supposed to cut in or out in proportion to the temperature change and demand for current.

Provision is made for removing any accumulation of scale and sludge at the bottom of the boiler.

For further description, literature of the manufacturer should be consulted.

#### Test

The test consisted in determining the temperature distribution of water in an insulated thirty gallon boiler, equipped with a Therm-Electric heater and thermostat. Temperature runs were taken starting with boiler cold, and then after drawing off specified amounts of hot water. Record was also kept of the number of heater sections in circuit. Temperatures were obtained by mercury thermometers inserted into the boiler. The boiler insulation was one inch of hair felt.

Test results are given in accompaning curve and log sheet.

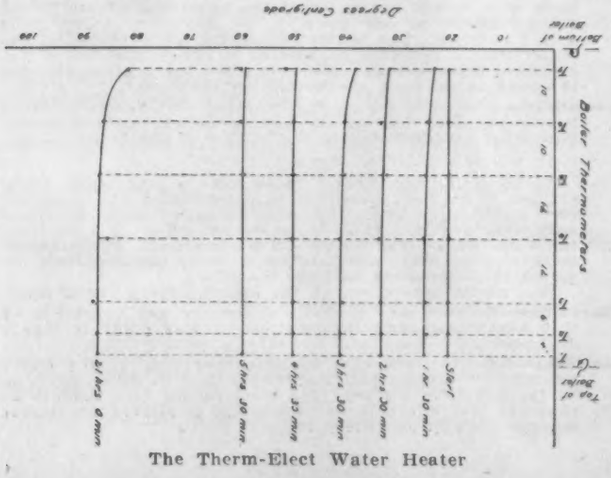
**Remarks**—From a study of test results the following conclusions are to be drawn:

Starting with a cold boiler, hot water is not accumulated in the top of the tank but all of the water in the tank must be heated before any is available at the desired temperature. Whether or not this is a practical objection will depend solely upon individual circumstances, chiefly upon the relation of storage capacity to daily needs.

When hot water is drawn off, any hot water left in the boiler remains in the top of the tank while the heating element warms the body of cold water below. During this time the temperature of the upper body of hot water gradually falls due to radiation and to heat conduction to the boiler shell and to the cold water below. When temperatures throughout the boiler have become approximately equalized, complete convection is resumed, and the entire body of water heated uniformly.

Due to the fact that the entire boiler contents are heated to approximately the same temperature, a maximum of heat storage is obtained for a given temperature setting of the thermostat.

Long life is claimed for the thermostat switch contacts and that the expansion and contraction of heater shell keep the element free from scale. Corroborative evidence, which could not be secured by laboratory test, is needed on both of these points. During this test the thermal switch contacts did not always open quickly or make good contact in closing, on which occasions appreciable arcing was observed. However, manufacturer states that operating records over several years show no trouble from this source and that none is to be expected, due to the nature of alloy used in the arcing tips and to the limitation of two hundred and fifty watts per contact.



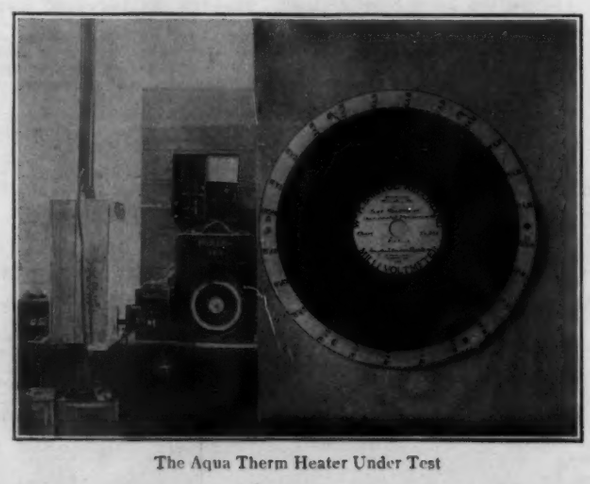

The Therm-Elect Water Heater

### Aqua Therm System

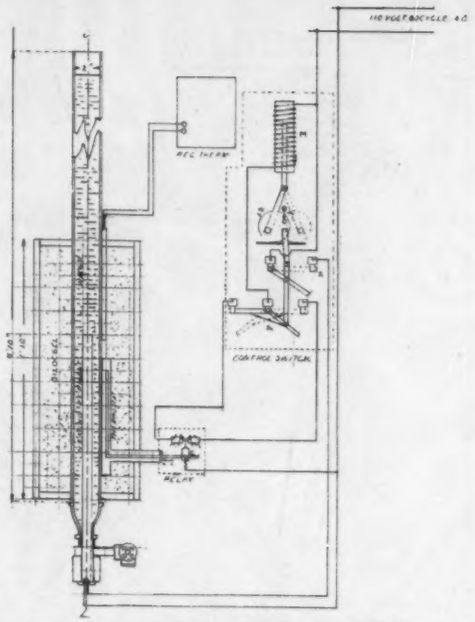
#### Preliminary Test

**Date Tested**—March 17, 1917.
**Type**—Type "H," Seriel No. 122. Immersion, automatic.
**Volts**—110.
**Amperes**—9.
**Heat**—Single.
**Overall Dimensions**—Will be included under a detailed description of apparatus.
**Weight**—Including heating unit, thermostat and switch, 19 lb.
**Construction**—There are four principal parts, heating unit, thermostat, control switch and boiler insulation.

The heating unit is of the immersion type, intended for insertion into the bottom of a domestic boiler. It consists of a resistance wire enclosed in a flat copper tube 15 in.



The Aqua Therm Heater Under Test




Connections for Test of Aqua-Therm Model H System

long which is sealed at the upper end but provided at the lower end with a 1 in. pipe fitting that will also permit of water being drawn off in order to flush out accumulated dirt and scale.

The thermostat utilizes the expansion and contraction of a bimetallic strip to operate an electrical contact, thereby energizing an electromagnet which operates a switch controlling the heating unit. It is intended to be strapped to the surface of the boiler before heat insulating material is applied.

The control switch consists of a single pole, single throw knife switch and a single pole, double throw knife switch, connected to the same operating rod and to the plunger of a solenoid. The solenoid is energized by operation of the thermostat and, in operating, either closes or opens the heater circuit and, at the same time disconnects itself from the line so that it is in circuit only for a small fraction of a second at each operation.

The complete equipment and electrical circuits are shown on the accompanying diagram. Heating element, thermostat and relay and control switch are so labeled. M is the operating solenoid, $S_1$ the single throw switch controlling heater circuit and $S_2$ the double throw switch that disconnects the solenoid M.

Operation is as follows: With cold water in the boiler the relay contact "C" moves to the **left** and energizes solenoid "M" through the left-hand blade of $S_2$. The plunger is connected to a weight "W" pivoted eccentrically at O, and which, due to the force of the upward pull, is thrown from the solid to dotted line position. To this weight "W" is fastened the operating switch rod, which is lifted by the rotation of weight "W," and in its travel closes "$S_1$", and throws over $S_2$. During the first period of this operation the force is due to magnetic pull from the solenoid "M," which however, is interrupted by opening of switch $S_2$. During the latter part of the travel of the switch blade the necessary operating force is impaired by the fall of the weight W. In this manner, quick and positive action and full travel of moving parts are secured through energy imparted to the weight W, although the operating solenoid is part of this time out of circuit. When the desired water temperature is reached the thermostat relay contact "C" moves to the right and again energizes the solenoid "M" through the right hand blade of $S_2$, throwing "W" back to its former position, disconnecting heating unit and solenoid.

The solenoid and switches are mounted in an iron box 12 in. by 6 in. by 4 in. with hinged cover.

The relay contact piece "C" is of sheet iron and is held in secure electrical contact by means of the small magnet $M_1$ or $M_2$, which it energizes with each operation. Contact is made at C but interrupted at $S_2$. The travel of relay contact C is about .02 inch for forty degrees Fahrenheit range. Control of the temperatures at which the thermostat will cut in or out is secured by adjustment of the contact pieces, $M_1$ or $M_2$ which are readily accessible. The thermostat relay is contained in an iron box 4 in. by 4 in. by 1½ in. with exposed and removable cover.

**Insulation**—The manufacturers provide, as part of this equipment a galvanized iron casing to enclose a standard thirty gallon boiler with an annular space of three inches which is to be filled with infusorial earth.

### Test

**Connections and Method**—In place of a standard boiler a two-inch pipe was used in order to obtain more rapid heating and cooling, with many more operations of the automatic apparatus than could be secured in a given time if applied to a thirty gallon boiler. A graphic recording thermometer was applied as indicated in the diagram, to show the temperature cycles and limits at which the thermostat would operate. The test consisted in a twenty-four hour run to observe temperatures and the mechanical operation of automatic apparatus.

**Efficiency**—100% for an immersion heater.

**Boiler Radiation Loss**—No test has yet been made with this equipment but results should be about the same as for the three-inch sil-o-cil covering previously reported.

**Temperature Range of Thermostat**—For this test the thermostat was adjusted to cut in at 135° and out at 175° F. The graphical temperature record is shown on page 232.

**Temperature Distribution in Boiler**—This heating element is similar to that used by the Therm-Elect heater and the heat distribution throughout the boiler should be alike in the two cases, if equally well insulated.

**Mechanical Operation**—Operation of the solenoid, M, was not satisfactory below 110 volts and at 103 volts it would not operate at all. Below 103 volts it was possible for the weight "W" to stick on dead center, in which case it could not be automatically restored but must be shifted mechanically. In this position there was sparking at all contacts, C, $S_1$ and $S_2$.

With sufficient voltage applied the solenoid is in circuit less than 1/10 of a second.

The quick break of switches reduces sparking to a minimum and insures long life of contacts.

The operation of the automatic switch is accompanied by considerable noise, which may be very annoying.

**Remarks**—The permanence of calibration of the thermostat is open to question but was not determined in this test.

In the heating element, the watts dissipated per unit of radiating surface appear unduly high, judging from past experience.

### Tests of Heat Insulating Materials

**Dates Tested**—August 19 and September 2, 1916.

**Materials Tested**—Single ply and three ply hair felt, fabricated by the H. W. Johns-Manville Company and known as "Economy Boiler Covering."

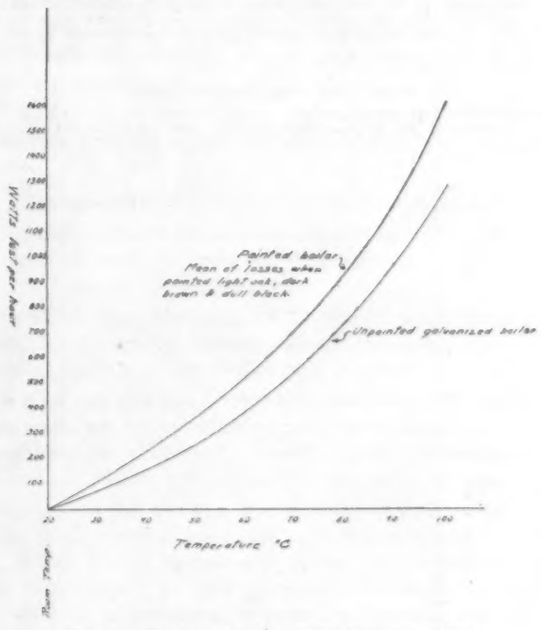
Powdered "Sil-o-cel" or infusorial earth, furnished by the "Kieselguhr Company of America."

Magnesia boiler covering.

**Description of Materials**—The "Economy Boiler Covering" consists of hair felt sewed up in canvas jackets, formed to fit a standard thirty gallon domestic boiler and held in position by lacing. The single ply covering consists of a single jacket, one inch thick. The three ply covering consists of three separate, concentric jackets, applied one over the other.

The magnesia was applied in the form of bricks to a total thickness of two inches, with an outer cloth covering.

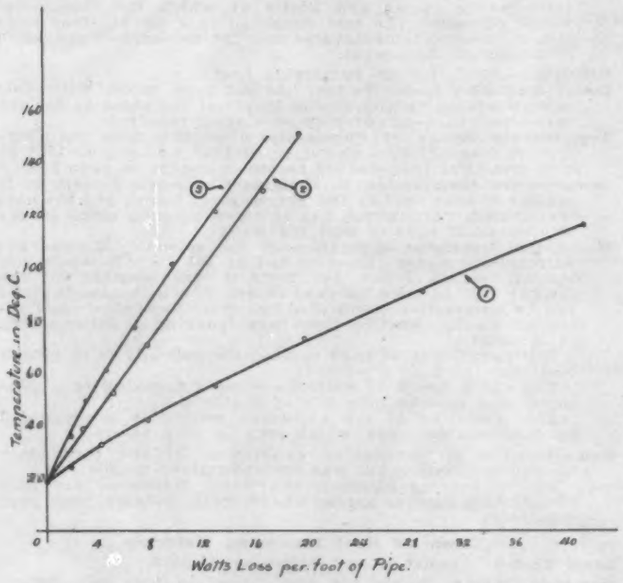
**Method of Test**—The purpose of test was to determine radiation losses from the boiler alone, disconnected from all piping. To that end the boiler was isolated and filled with water, which was heated to approximately the boiling point and the time-temperarue curve in cooling was determined. From the cooling curve and known quantity of water the radiation loss in B.t.u. or kilowatts can be readily calculated. Water temperature was determined by means of an immersed copper resistance thermometer extending from top to bottom of boiler, which gave the average temperature as desired.


Painted boiler
Mean of losses when painted light oak, dark brown & dull black.
Unpainted galvanized boiler
Temperature °C
Room Temp.

Test of Losses of Bare and Painted Boiler

**Test Results**—Are given on the accompanying curve sheets.

**Remarks**—The heat loss from even a well insulated boiler is so large that, where, hot water is to be stored for any length of time and electricity for heating is sold on an energy basis, the best insulation obtainable should be used.




Test of Various Types of Pipe Covering

(Curve 1 is for ¾ in. bare galvanized iron pipe, curve 2 for the same pipe as curve 1, but insulated with "Economy" laced pipe jacket, and curve 3 is the same as curve 1 but insulated with 85% magnesia.)

**Heat Loss from Uninsulated Boiler**

**Date Tested**—August 21, 1916.

**Purpose of Test**—To determine the effect of the condition of boiler surface upon losses due to radiation and conduction from an uninsulated tank, at temperatures below 100 deg. Centigrade.

**Method of Test**—The same method was employed as that described under "Tests of Heat Insulating Materials." Four surface conditions were investigated, as follows:
Losses from boiler with bright galvanized surface.
Losses from boiler when painted light oak.
Losses from boiler when painted dark brown. (Second coat).
Losses from boiler when painted dull black. (Third coat).
The boiler under test was placed on a wooden stand in the middle of a room where the air could circulate freely about it.

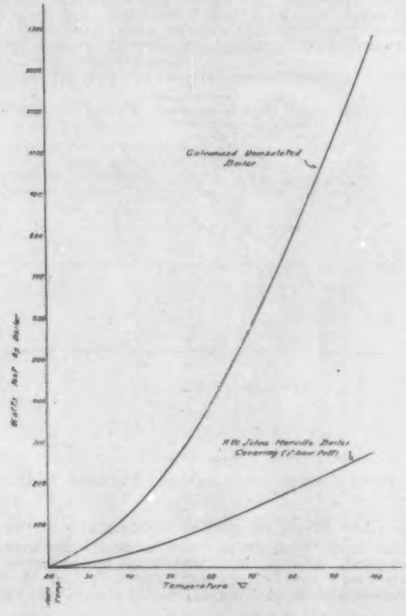
**Test Results**—Are given in the accompanying curve sheet.

**Remarks**—The magnitude of the loss from an uninsulated boiler is so great as to compel the use of heat insulation wherever hot water is to be stored for even short periods of time and electricity used for heating is sold on an energy basis.
Adequate heat insulation will probably also pay where a cheaper fuel is used to heat water.

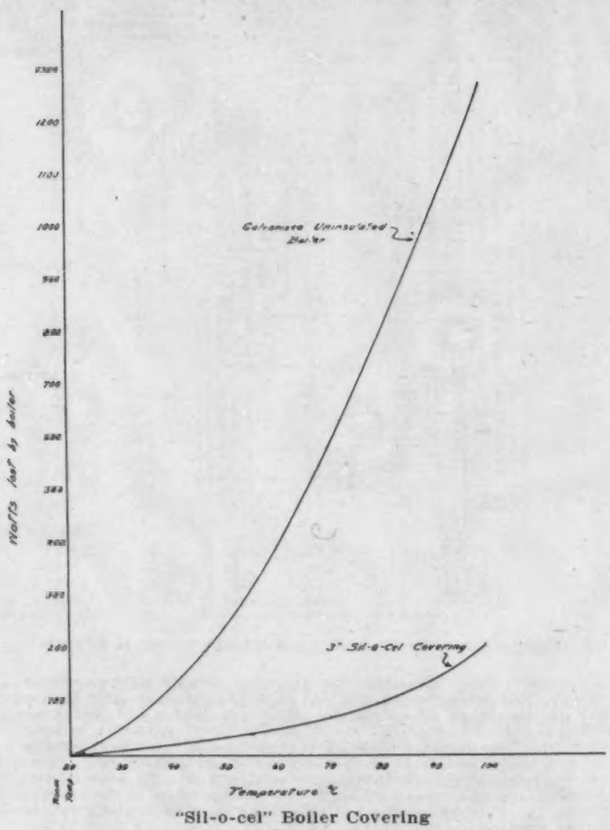
**Heat Loss from Water Piping**

**Date Tested**—August 23, 1916.

**Pipe Tested**—¾ in. galvanized water pipe as follows:
Bare.




Test of "Economy" Boiler Covering, Single Ply

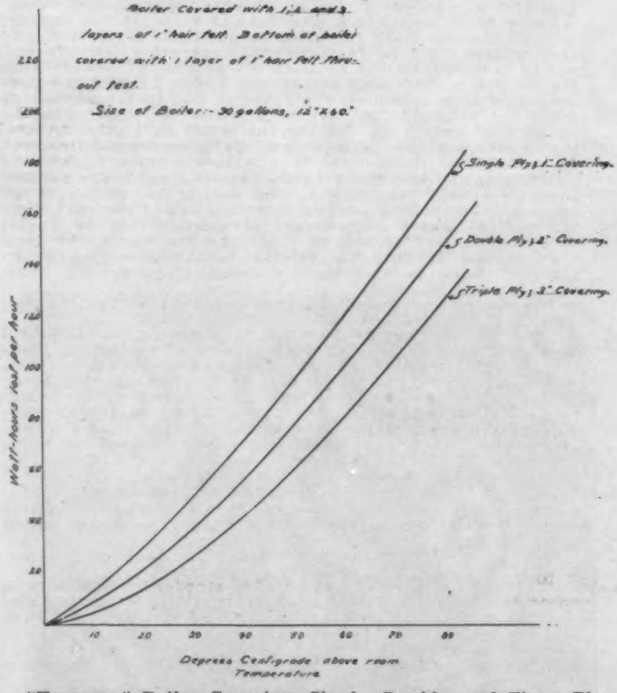



"Sil-o-cel" Boiler Covering

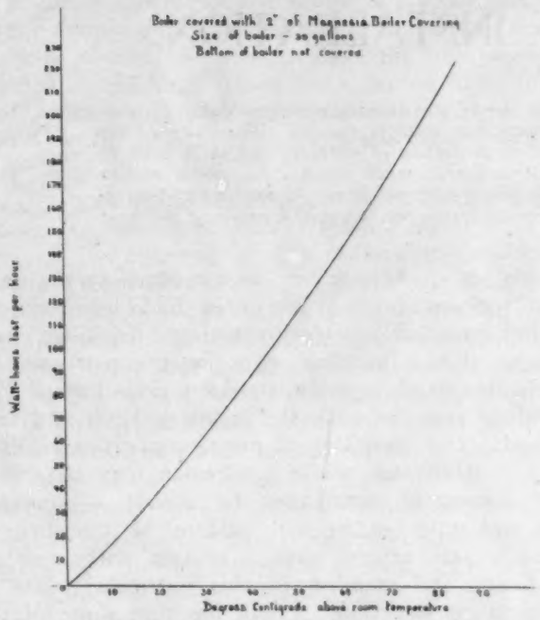
Insulated with ¼ in. hair felt sewed up in a laced canvas jacket. Marketed by the H. W. Johns-Manville Company as "Economy Laced Pipe Jacket."
Insulated with 1 inch of 85% magnesia.

**Method of Test**—Temperature of the pipe was determined from its electrical resistance, after first calibrating at 21.5° C. and 100° C. by passing through it cold water and steam respectively. Heat losses were supplied electrically by direct current, the same measurements determining energy loss and resistance.

A preliminary test was made to discover any difference in losses with pipe horizontal or vertical, but none could be detected. All observations were therefore taken on a 10 ft. length mounted horizontally in free air.


Boiler Covered with 1, 2 and 3 layers of 1" hair felt. Bottom of boiler covered with 1 layer of 1" hair felt throughout test.
Size of Boiler:- 30 gallons, 12" x 60"
Single Ply 1" Covering.
Double Ply 2" Covering.
Triple Ply 3" Covering.
Degrees Centigrade above room Temperature.

"Economy" Boiler Covering, Single, Double, and Three Ply


Boiler covered with 2" of Magnesia Boiler Covering
Size of boiler – 30 gallons
Bottom of boiler not covered
Watt-hours lost per hour
Degrees Centigrade above room temperature

Test of National Magnesia Boiler Covering

Potential wires were placed 18 inches from each end.

The insulation available left six inches of bare pipe at each end. In order that none of the loss from the uncovered ends might be supplied by conduction from the section under test, these ends were kept as nearly as possible at the temperature of this section.

**Test Results**—Are given in accompanying curve sheet.

**Remarks**—Piping losses are of principal importance in connection with the circulation pipe, if one is used, which connects heater and boiler, and of possibly less importance in connection with the hot water service pipes because of the short periods for which they are in use.

If we assume the curves of these tests to be straight lines between the limits of 40 deg. C. and 80 deg. C., which covers the range of domestic hot water service, then the radiation losses per foot of pipe per degree Centigrade temperature difference above the surrounding air are as follows:

¾ in. Bare pipe .30 watts per ft. per deg. C.
¾ in. Pipe, "Economy" covering, .15 watts per ft. per deg. C.
¾ in Pipe, magnesia covering, .11 watts per ft. per deg. C.

A 30 gallon boiler can easily be insulated so that the loss at 60 deg. C. with 20 deg. C. room temperature is about 75 watts. The circulation pipe, if a circulation heater is used, with allowance for elbows, tees and the increased area of fittings, will have a length equivalent to about eight feet of straight pipe. Under these conditions the losses would be about as follows:

| Kind of Pipe Covering | Loss in Pipe | Loss in Boiler | Ratio of Pipe Loss to Boiler Loss |
|---|---|---|---|
| Bare pipe | 96 watts | 75 watts | 128% |
| Economy | 48 watts | 75 watts | 64% |
| Magnesia | 35.2 watts | 75 watts | 47% |

To this loss in the circulation pipe must be added the heater loss.

From these figures it is reasonable to conclude that the circulation pipe and heater should be insulated with as much care as the boiler itself. Furthermore, even with the best insulation obtainable, where hot water is to be stored for any length of time, the total losses with an immersion heater are probably from twenty to thirty per cent less than with a circulation heater.

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## ELECTRICAL UTILIZATION SAFETY ORDERS IN CALIFORNIA

BY JAMES M. BARRY

The recently enacted Electrical Utilization Safety Orders have caused many departures in the methods of making electrical installations. With a view to clearing up certain difficulties which have arisen, the following brief discussion by the department of electricity of San Francisco is submitted:

### Location of Main Service Switches

Order 735 (a) states that main service switches "shall be placed in the nearest readily accessible place at the point where the wires enter the building and arranged to cut off the entire current." This requirement conflicts with the provisions of Section "J," Ordinance 2582.

Since the state law takes precedence over the city ordinances wherever the latter are in conflict with the former, Order 735 (a) only must be given consideration in the location of main service switches.

Complying with Order 735 (a), main service switch will usually be located as indicated for each of the following classes of buildings:

**Office Buildings.**—On main bulkhead in basement as near stairway as possible.

**Apartment Houses With Basements.**—On main bulkhead in basement as near stairway as possible.

**Apartment Houses Without Basements.**—Immediately within the door of tradesmen's entrance.

**Garages.**—As near the main entrance as practicable.

**Flats and Dwellings.**—Immediately within the door of tradesmen's entrance. If service comes in from the rear, as is the case in many residence parks, main service switch shall be located in rear of the building.

The foregoing is intended as a guide only. The department reserves the right to exercise its discretion in interpreting Order 735 (a). In submitting the above suggestions, it is not the intent of the department to deviate from the provisions of Order 735 (a).

### Kind of Switches to Use

(1) All switches, regardless of voltage, must be of the bottom fused type, with the service coming in at the top, so that blades and fuses will be dead when switch is open.

(2) Switches to be used in two-wire and three-wire a.c. single-phase services of less than 150 volts to ground need not be of the externally operated type unless they are located in permanently damp places or where local conditions entail a particular hazard.

(3) All service switches, except those noted under (2) shall be of the externally operated type. Externally operated switches shall fulfill these conditions.

(a) The cover of the cabinet containing the switch shall be so interlocked with the switch mechanism that the cover cannot be opened until the switch is opened.

(b) The cover shall be so interlocked with the switch mechanism that the switch cannot be closed while the cover is open.

### Disconnection of Fusible Cutouts Before Handling

All main circuits and branch circuits, except branch lighting circuits, shall be provided with switches to disconnect the circuit fuses before handling.

This means that a separate switch will be required for every circuit, except **branch lighting circuits** emanating from panel boards or centers of distribution in a building.

Where one lighting circuit supplies the entire current to a consumer, as, for example, in some apartments, such a circuit **will not** be considered a branch lighting circuit; in every such case, a switch will be required ahead of the cutout.

Where several switches are grouped at a center of distribution, these switches need not be of the externally operated type, if they are not operating switches. In the ordinary case, these switches will be used merely for disconnecting the cutouts when it is necessary to re-fuse a circuit. The cabinet containing the fused switches shall have marked on the cover a warning against the removal of fuses until the switch controlling same is opened.

Where switches at centers of distribution are used to actually control apparatus such as motors, furnaces, etc., these switches must be of the externally operated type.

# STANDARD CONDUIT INSTALLATION

BY L. A. BARLEY

*(Conduit construction offers a broad field for discussion as to its advantages, disadvantages, comparative cost, installation rules, and a host of other questions that arise in the art. The rules of the Fire Underwriters for conduit construction are important in protection to property and in security to life. Herein are discussed salient features of conduit construction of much interest to central station managers and men of the electrical industry by an author who is with the Rocky Mountain Fire Underwriters, with headquarters at Denver. This paper was delivered before the recent convention of the New Mexico Electrical Association.—The Editor.)*

The subject assigned me for discussion at this, the third annual meeting of the New Mexico Electrical Association, I believe to be of general interest to all central station men as well as to electrical contractors and wiremen. The advantages, disadvantages, comparative cost, installation rules, etc., of metal conduit construction offer a broad field for discussion. However, I will only attempt to touch upon some of the more important features which I believe should be of especial interest to the members of this Association.

The use of metal conduit in this state, until within the last two or three years, has been comparatively limited and the inside wiring in general has too often been installed in the cheapest manner possible. This, I feel, was due largely to the inferior type of early building construction which would not warrant permanent or expensive electric wiring systems; also the property owners in many instances did not seem to realize the importance of having the wiring installed in accordance with the national rules and the best engineering practices for the safe-guarding of the fire hazard and securing effective and economical distribution of electric current. I am pleased to observe, however, that within the last year or two there has been a very noticeable improvement in the class of building construction throughout the state, carrying with it a better class of electric wiring installation.

With buildings of reinforced concrete or protected steel construction it is necessary, owing to the nature of such construction, to employ the conduit type of wiring. Many of the more progressive architects and builders are now insisting on conduit in the better class of buildings of ordinary brick or stone construction.

It is generally conceded that metal conduit construction, properly installed, constitutes the safest and must permanent method of electric installation. The various electrical associations, fire prevention bureaus, and fire underwriters, in formulating the rules and requirements of the National Electrical Code, have recognized this fact and have made conduit construction a mandatory requirement in certain risks of an especially hazardous nature, such as automobile garages, theaters and motion picture houses. It is likely that this requirement will be extended within the next year or two to apply also to all public buildings, schools and churches.

The average merchant or business man is, I find, often under the impression that any metal conduit installation absolutely eliminates any possible chance of an electric fire. If the system is installed in a proper manner in accordance with the rules governing this class of construction, the chances for any trouble on the system has been reduced to the minimum without doubt. We often find, however, the conduit installed in a very crude and unskilled manner and, if in a building of ordinary construction, it constitutes, in my opinion, a more serious hazard than would be possible with the ordinary knob and tube method. The installing of metal conduit is really a trade in itself and, while a wireman may be skilled and thoroughly competent to install a standard knob and tube job, he will seldom be qualified to install a satisfactory conduit system without some experience and training in this particular class of electrical construction. I will mention some of the more common defects found in this class of wiring.

One of the most important features frequently neglected is the grounding and bonding of the conduit system. The code rules specify that metal conduits containing service wires must be insulated from the conduit system and all metal work in the building (which is seldom practical), or be permanently and effectually grounded to water piping or other suitable grounds. Connections to ground pipes and to the conduit system must be exposed to view or accessible, and must be made by means of approved ground clamps. Where the largest wire contained in the conduit is not greater than No. 0, the ground wire must be of copper at least No. 6 B. & S. gage, and No. 4 where the largest wire in the conduit is greater than No. 0.

If the entire conduit installation is one continuous system or has the separate sections thoroughly bonded together, the ground on the service conduit will be sufficient for the entire system. In mixed knob and tube and conduit work it will be necessary to bond the separate sections of conduit together or ground each portion separately. While the code rules do not make any provision for omitting the grounds on short lengths of conduit, it is the general practice to not provide grounds for conduit runs of say 8 or 10 ft. in length. In selecting a proper grounding pipe it is best to connect to some permanent piping not less than three-fourths of an inch in size where available; otherwise, the ground connection is liable to be disturbed and may be entirely removed by the plumbers or other workmen in replacing or moving piping of a less permanent nature. Especial care must be taken to see that all rust or enamel is removed from pipes at connections and the bonding clamps must be tightly secured in place to maintain an effective electrical contact. If the ground wire is subject to mechanical injury, it must be protected in a substantial manner by piping or moulding. In buildings where no grounding pipes are available it is often necessary to drive a pipe into the ground either on

the inside or outside of a building at a point near the service entrance. If located on the outside of building, care should be taken to have the pipe securely fastened to building or pole and guarded from injury from wagons and other vehicles. The ground pipe should extend at least 7 ft. above the ground in such cases.

The location and arrangement of the service cabinet and service devices is another feature of material importance. The code rules state that "an automatic cutout shall be placed on all service wires in the nearest accessible place to the point where they enter the building and inside the walls." With the ordinary low potential light and power installations, the automatic cutout consists of a two or three pole fuse block. The service switch must also be located at this point but is now permitted placed on either side of the cutout. Both of these devices must be arranged to cut off the entire current from all devices, including meters.

Owing to the fact that the service wires, up to the point where the service cutout is located are without fuse protection except that afforded at the transformer (which in most cases would far exceed the safe carrying capacity of the wires), it is very essential to have these devices located as near as possible to the point of service entrance, thereby reducing to the minimum the length of unprotected conductors within the building. The service switch, to be readily accessible (as required), must be located not over 7 ft. above the floor. To secure a readily convenient location for the switch and have the two devices installed in the same cabinet, it is sometimes advisable to make some sacrifice in nearness of the cabinet to service entrance, but the distance from point of entrance to service cabinet must in no case exceed 15 ft.

The service conduit must be equipped at outer end with approved condulet or pot-head fittings of the waterproof type and must be continuous (without junction or pull boxes) into cabinet. The cabinets must be of sufficient size to contain the devices without crowding and with required space between exposed current carrying parts and walls of cabinets. All cabinets must be constructed in accordance with the standard requirements and bear the Underwriters Laboratories' label of approval. Cabinets, when used for the enclosure of apparatus connected within the cabinet to the wires of more than four circuits, not including the supply circuit or a continuation thereof, shall have a back wiring space or one or more side wiring gutters, or side wiring compartments, unless the wires leave the enclosure directly opposite their terminal connections.

Meter loop outlets must be equipped with approved type outlet boxes or condulet fittings with separate porcelain bushed holes for each wire, or with cover constructed entirely of porcelain with separate holes for each wire. When meter is located directly adjacent to cabinet, the meter loops may be brought out of the enclosure through separate, porcelain bushed holes. Junction, outlet boxes, etc., must always be installed in such a manner as to be readily accessible. We quite frequently find this rule violated in mixed construction, the junction box being concealed between ceiling and floor in places where it is necessary to run down a brick wall in conduit for switch loop. The proper method would be to locate the junction box in the ceiling, flush with the plastering and equipped with blank cover. Where this would be objectionable on account of the appearance, the conduit could be extended to the nearest light outlet in the ceiling and the box located at this point. The canopy of the fixture would thereby conceal the box from view. Conduit should be securely supported and installed in a neat workmanlike manner, free from sharp bends that would tend to flatten or injure the conduit; also should enter cabinets, junction boxes, etc., at right angles and not in a diagonal manner.

The wireman should be provided with all necessary fittings, pipe bending tools, etc., if he is expected to install conduit in a satisfactory manner and without waste of time. In all classes of wiring, we find that a neat job usually proves to be a good job. The electrical contractor or wireman should always remember the old saying, "What is worth doing at all is worth doing well."

## WEIGHTS AND MEASURES BY BUREAU OF STANDARDS

A new publication of the Bureau of Standards entitled "Eleventh Annual Conference Report, Weights and Measures, 1916," has just made its appearance. This report is a record of the proceedings of the conference, which is a body composed of state and local weight and measure officials from all parts of the United States. Some of the principal matters contained therein are short reports on legislation and general conditions existing in the United States; suggestions, discussions, and resolutions as to the proper method of sale of coke, of fruits, vegetables, etc., and of wrapped meats; technical papers on the selection and maintenance of apparatus in industrial plants, on the inspection, test, installation and maintenance of railroad track scales, and on liquid-measuring pumps; reports and discussions in relation to the adoption and use of the metric system of weights and measures, and of the Centigrade scale of temperature; and discussions by manufacturers of weights and measures and weighing and measuring devices of tolerances and specifications, of new types of scales, and other matters of interest. The tolerances and specifications for weights and measures and weighing and measuring devices heretofore adopted, were broadened by the addition of several new classes of apparatus, and the complete tolerances and specifications are included as an appendix to this publication.

## REPORT ON PETROLEUM FOR 1915 ISSUED

A publication of considerable general interest now available for free distribution by the United States Geological Survey, Department of the Interior, is the annual statement on petroleum in 1915. This report on development in the oil fields of the United States during the year includes brief notes on the trend of developments in foreign oil fields so far as conditions can be ascertained.

# AMERICAN OPPORTUNITIES IN CHINA

BY JULEAN ARNOLD

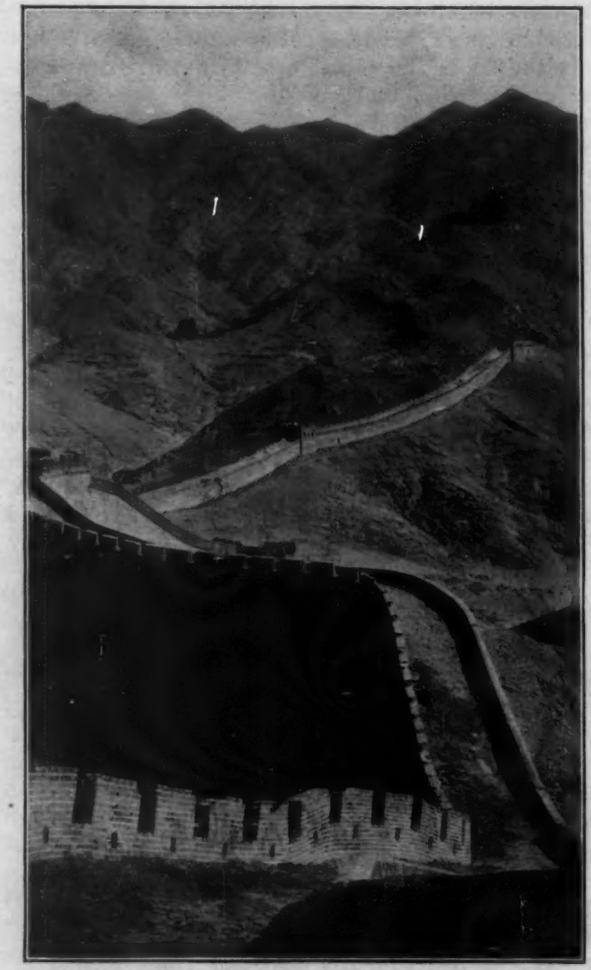
*(Engineering and commercial bodies up and down the Pacific Coast are giving much study to American opportunities in countries bordering the Pacific. Here is an eloquent appeal by the American commercial attache to China, who has given fifteen years of study to the question of American opportunities in that country. The matter contained in this article has been prepared for the columns of the Journal by the author from a recent paper presented by him before the Oregon Society of Engineers and from a paper to be presented before the San Francisco Electrical Development and Jovian League on April 4, 1917. The illustrations are taken from a collection made by the editor of the Journal while on a recent tour of the Orient in the interests of gathering data for forecasting the engineering outlook in that section of the world in its relation to the Pacific Coast.—The Editor.)*

Moonlight on the Yangtze, a Navigable River Serving More People Than Any Other Inland Water Source in the World

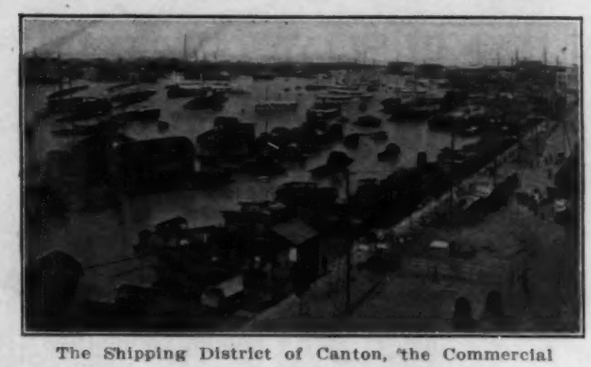
WE read much in our newspapers and trade journals about the opportunities for trade in South America and much is being done to avail ourselves of these opportunities. While we should do everything possible to encourage our trade in South America, yet in so doing we should not overlook a field of far vaster opportunities than South America can offer. Few of our people seem to appreciate the fact that China has a population ten times as great as the aggregate population of the whole of South America. Few people seem to realize that although Chinese civilization extends back 5,000 years, China is today one of the richest countries in undeveloped natural resources on the face of the globe. China possesses a store of wealth in iron, coal, lead, copper, zinc, tin, antimony and other base metals as great or greater than that of the United States.

Although China has what will probably prove to be as rich and as extensive deposits of coal as has the United States, yet China today imports coal. Where coal and iron abound in large quantities, especially when combined with a dense population of peace-loving industrious inhabitants, there modern civilization will take its path. China also has a vast wealth in undeveloped water power. Up to the present industry in China has been of the household variety. No incentive has been given to the people by the State in invention. Stop and think what our patent laws have meant to our industrial development. Can you conceive of this development without federal protection and encouragement to invention? China has been without this. The steamboat, the locomotive, the telegraph, the sewing machine, the telephone, the gasoline engine, the aeroplane have called great industries into existence as have also many other of our inventions. Through modern inventions 5,000,000 are today doing in our factories with the aid of patent covered inventions what would be impossible with the labors of twenty times this number.

Although China is an agricultural nation, about 80 per cent of its people being engaged in agriculture, yet she has not the advantages of one of the 50,000 patents issued in the United States to cover agricultural implements and machinery. Although China embraces an area as large as the United States, Mexico and Central America combined, yet vast areas of the richest sections of its country are cut off from the markets of the world and from commercial intercourse with the rest of the nation, because of the lack of railways. China has today 6000 miles of railways and will require upwards of 100,000 miles to handle her transportation needs. In sections devoid of waterways and yet unconnected by rail, native methods of transportation, even with labor selling at ten cents a day, are from ten to twenty times as expensive as rail trans-



The Engineering Feat of All History, the Great Wall of China, Sixteen Hundred Miles in Length



The Shipping District of Canton, the Commercial Mecca of Southern China

portation in the United States, with wages twenty times as high.

Think of what our electrical developments have meant to our progress and then see China with four times the population and with a wealth of water power yet with no generating plants for electricity. The efficacy of modern education, of western learning is now recognized by China and her educational system since 1905 has taken cognizance of her past shortcoming in this direction. China is today at the threshold of a grand industrial development. She now wants railways, factories, electrical power plants, and is preparing to open her vast stores of mineral resources. No stretch of the imagination can conceive of the stupendous extent of the developments which will take place in China during the next few decades. The commercial opporunities which will follow in the wake of these developments will result in shifting the world's commercial arena from the Atlantic to the Pacific. Is America preparing for these marvelous opportunities? What country should be able to profit by them to a greater degree than should the United States? What country is better capable of handling the big things in mining, railroading, engineering, and industry than the United States? What people are in a position better to finance these big activities than are the people of the United States?

Fortunately for us China welcomes American participation in the creation of the new China, in fact China prefers American to all other assistance, for she has learned through experience with the nations of the West, that America does not stand for the exploitation of China for selfish aims, that America respects her territorial integrity, that America has China's welfare at heart. Thus China begs for American assistance and American participation in the rebuilding of her country, in the opening of her vast treasure houses of natural wealth, and in establishment of a sound political and economic system. Americans have been too prone to entrust their interests and opportunities in China to those of other nationalities.

Can we not do the work in China for ourselves and as well, if not better than others? The only way to meet the great big opportunity staring us in the face over there, is to do it through our own organizations. We must go over them and take our capital, material and technical skill with us. That is what China asks and wants us to do. No other country on the face of the earth offers opportunities of such magnitude and no other people on the face of the earth are so kindly disposed and so friendly toward us as are Chinese. Do not let us be frightened off by reports of revolutions and rebellions. China is no second Mexico. During her revolutions and rebellions no foreign lives were endangered. All foreign property losses suffered during these trying times were indemnified in full by the Chinese government. Moreover China has always met her foreign obligations fully and promptly. What better record can we ask? Our biggest opportunity lies across the Pacific. We are asleep to this fact.

We should be making a serious study of this our most important question. We should do everything in our power to bring China to the United States, so that our people may know that country and its people better, for in knowing them better, they cannot but be impressed by the marvelous opportunities which that country has in store for us. We must get the habit of thinking China.

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## SIZE OF FRESH WATER LAKES OF THE UNITED STATES

*(Considerable discussion has of late prevailed in certain districts of the West as to the relative size of fresh water lakes in the United States, without taking the Great Lakes into consideration. A recent letter from the Acting Director of the United States Geological Survey will entirely clarify the situation as set forth in the letter that follows.—The Editor.)*

Sir:

The following list comprises what are believed to be the 15 largest fresh-water lakes in the United States:

Lake of the Woods, Minnesota and Canada, 1500 square miles, Encyclopedia Britannica.

Tulare Lake, California, varies from 0 to 800 square miles. U. S. Geological Survey Water-Supply Paper 299.

Okechibee, Florida, 730 square miles. Report of Florida Everglades Engineering Commission; Senate Document 379, Sixty-third Congress, second session.

Pontchartrain, Louisiana, 625 square miles. Planimeter measurement on General Land Office map.

Salton Sea, California. (Dec. 31, 1908), 443 square miles; shrinking. U. S. Geological Survey Water-Supply Paper 290.

Red Lake, Minn. (both lakes), 441 square miles. Report of State Drainage Commission of Minnesota, 1911-1912.

Lake Champlain, New York and Vermont, 436 square miles. U. S. Geological Survey Water-Supply Paper 284.

Lake St. Clair, Michigan and Ontario, 410 square miles. Lakes of North America, by I. C. Russell.

Rainy Lake, Minnesota and Canada, 310 square miles. Report of State Drainage Commission of Minnesota, 1911-1912.

Leech Lake, Minn., high water, 234 square miles; low water, 173 square miles. Report of State Drainage Commission of Minnesota, 1911-1912.

Mille Lacs, Minn., 207 square miles. Report of State Drainage Commission of Minnesota, 1909-1910.

Winebago Lake, Wis., 215 square miles. Wisconsin Geological and Natural History Survey Bulletin 36.

Lake Tahoe, Cal., 193 square miles. U. S. Geological Survey Water-Supply Paper 290.

Flathead Lake, Montana, 188 square miles. Planimeter measurement on U. S. Geological Survey base map (scale 1:500,000) of Montana.

Utah Lake, Utah, 145 square miles. U. S. Geological Survey Water-Supply Paper 290.

PHILIP S. SMITH, Acting Director.

# WITCHING FOR WATER WITH WILLOW SWITCH

*(Perhaps no discussion in the West has been more broadcast among informal gatherings than that relating to the so-called "water witch" and his power to locate underground sources of water supply by means of the willow twig. Witching for water is evidently not a new accomplishment if ever it may have been said to have arrived at the stage of being called an accomplishment, for the following article, prepared by the Director of the United States Geological Survey, shows that it is founded upon an ancient superstition disseminated broadcast throughout the civilized world.—The Editor.)*

The idea that a forked twig, or so-called divining rod, is useful in locating minerals, finding hidden treasure, or detecting criminals is a curious superstition that has been a subject of discussion since the middle of the sixteenth century, and still has a strong hold on the popular mind, even in this country. This is evident from the large number of inquiries received each year by the United States Geological Survey, Department of the Interior, as to the efficacy of such a twig, especially for locating underground water. To furnish a reply to these inquiries the Geological Survey has published a brief paper, by Arthur J. Ellis, on the history of water witching, with a bibliography that includes a truly astonishing number of books and pamphlets on this uncanny subject.

In summary the paper states: It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited. It is by no means true that all persons using a forked twig or some other device for locating water or other minerals are intentional deceivers. Some of them are doubtless men of good character and benevolent intentions. However, as anything that can be deeply veiled in mystery affords a good opportunity for swindlers, there can be no reasonable doubt that many of the large group of professional finders of water, oil, or other minerals who take pay for their "services" or for the sale of their "instruments" are deliberately defrauding the people and that the total amount of money they obtain is large. To all inquirers the United States Geological Survey therefore gives the advice not to expend any money for the services of any "water witch" or for the use or purchase of any machine or instrument devised for locating underground water or other minerals.

**History of the Superstition.**—In tracing the history of the subject it is found that divining rods have been used (1) to locate ore deposits, (2) to discover buried or hidden treasure, (3) to find lost landmarks and re-establish property boundaries, (4) to detect criminals, (5) to analyze personal character, (6) to cure diseases, (7) to trace lost or strayed domestic animals, (8) to insure immunity against ill fortune by use as a fetish, (9) to locate well sites, (10) to trace the courses of underground streams, (11) to determine the amount of water available by drilling at a given spot, (12) to determine the depth at which water or ores occur, (13) to determine the direction of cardinal points, (14) to determine the heights of trees, and (15) to analyze ores and water.

The origin of the superstition is lost in antiquity. What is believed to be the first published description of the divining rod is contained in Georgius Agricola's "De re metallica," which was published in 1556. The device became common first in Germany as a means for locating mines and also for discovering buried treasure, a matter of rather common interest in those days, when the practice of burying money and plate for safe keeping was very general. It was introduced into England by German miners during the reign of Elizabeth (1558-1603), and before the end of the seventeenth century it had spread through the countries of Europe. Everywhere it aroused controversy. The rules prescribed for the cutting of the twig partook largely of heathen sorcery and astrology. There were indeed, to some extent, unconscious reminiscenses of the old Scandinavian and even of the Aryan mythology. But this heathen influence was offset when the rod was duly Christianized by baptism, being laid for this purpose in the bed with a newly baptized child, by whose Christian name it was afterward addressed. It is readily conceivable that the motive for surrounding this practice with a religious atmosphere might not have been altogether a belief in its divine character, for at that time any one found engaged in mysterious works was in danger of being charged with sorcery and burned to death.

**Recent Discussions.**—In the later part of the eighteenth century an attempt was made to explain water witching as an electric phenomenon, and later it was discussed as a psychic phenomenon. At almost every step in the advance of science some one has attempted to explain its supposed operation by means of the latest scientific theories.

Before the present war there were several societies in Germany whose sole object was said to be the study of the divining rod. In 1910 the department of agriculture of France appointed a committee to investigate the subject, and in 1914 this committee was still investigating.

A copy of the Government report, which is published as Water-Supply Paper 416, can be obtained by addressing the Director, United States Geological Survey, Washington, D. C.

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**A unique service** has been inaugurated by the Southern Pacific Company to provide a simple inexpensive lunch service for coach passengers who may not desire a meal in the dining car. A neatly equipped "wagonette," loaded with tempting but simple edibles consisting of sandwiches, lunch boxes, fruit, pies, cold meats, hot coffee and chocolate in thermo bottles with necessary cups, saucers, knives and forks, is wheeled through the car by the traditional black-faced gentlemen, spotless in white garments and head gear.

# COST OF BROODING BY ELECTRICITY

BY E. A. WILCOX

*(In the issue of the Journal for February 1, 1917, an article was published on "Incubating and Brooding by Electricity," which has created so much interest among readers of the Journal that we publish herewith a second installment on costs involved in this recent application of electrical energy to the great chicken-raising industry of the West. The author, who was formerly electric heating specialist for the Great Western Power Company has recently compiled a most useful book on Electric Heating published by the Technical Publishing Company of San Francisco from which this article is taken.—The Editor.)*

**Brooding of Chickens.**—The chick which is taken from the incubator to the brooder at the age of twenty-four hours (and known as a "day old chick") is not fed for another similar period or until the chick is about forty-eight hours old. The reason for this, is that the chick has absorbed the yolk of the egg into its digestive organs just prior to pipping, and continues to live on this food for the entire forty-eight hours. The chick's first meal should consist of grit, such as coarse sand, after which it may be fed some good chick food.

The temperature of the brooder should be kept at about 95° F. for the first week and gradually dropped for the next five weeks or until the chick is sufficiently matured to roost. It is important to watch the temperature carefully with very young chicks, because otherwise they will become restless and crowd together as soon as their backs get cold. If the crowding becomes too severe, the chicks will sweat and become weak and the less rugged ones may be smothered.

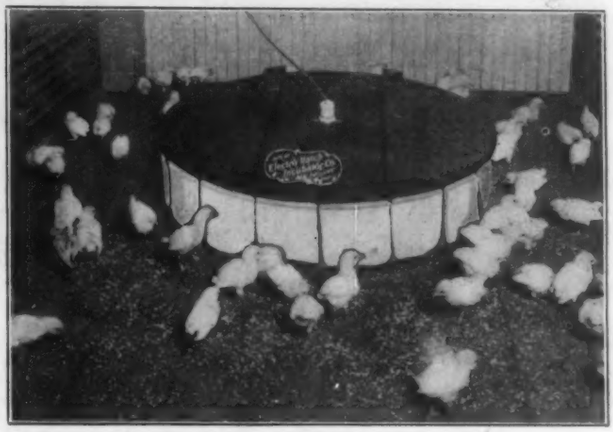
Rectangular Type Chick Brooder in Operation

A chick demands plenty of oxygen, (about 10 times as much as a person in proportion to its weight), and if it is to mature rapidly and develop good lungs, the brooding must be done in a well ventilated room. The chick should not be subjected to drafts of air, however, and best results are secured in a room having a tight floor and provided with high ventilation. The temperature of the room is immaterial as long as the proper degree of heat is maintained inside the brooder. Coarse straw or sand is usually spread out beneath the brooders.

**Electric Brooders.**—These devices are built in round, square, or oblong shapes, and in capacities of from 50 to 1200 chicks. The tops of the hovers are usually made of wood insulated beneath with asbestos, and supported on short wood or metal legs. Strips of canvas or oilcloth, wide enough to reach the floor and retain the heat, are fastened around the outer edges, and slitted perpendicularly every few inches to allow the chicks to pass in and out readily.

In the circular type hover, the heating element is placed in the center of the top, and in other types coiled wire heating elements are arranged around the top, in order to secure a wider distribution of heat. The air, when heated, banks against the insulated top and settles down upon the backs of the chickens. One or more holes are generally drilled in the floor beneath the machines to introduce a proper amount of fresh air inside.

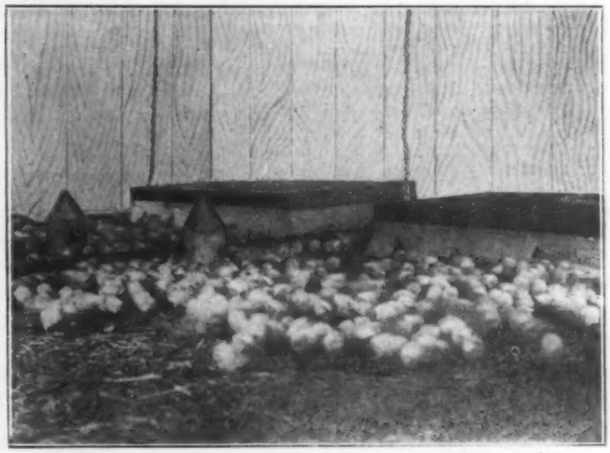
The thermostat for regulating the temperature inside the hover is mounted a few inches below the top and adjusted by a screw on the outside.



Round Type Electro-Hatch Hover in Operation

A well constructed brooder is usually provided with about 100 watts capacity per hundred chicks. The current consumption has been found to average about 20 kw-hr. per hundred chicks.

**Advantages of Electric Brooders.**—Almost all the advantages that apply to electric incubators, apply as well to electric brooders. They save time, labor, and anxiety. They insure even heat distribution, easily

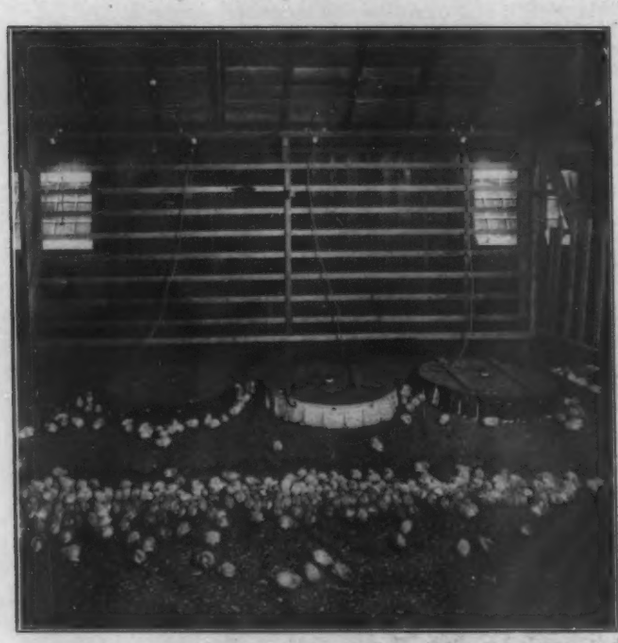


Electro-Hatch Rectangular Type Brooders in Operation

controlled temperatures, and elimination of fire hazard. The electric heat neither burdens the atmosphere with poisonous fumes, nor destroys its oxygen. It has furthermore been demonstrated in actual practice, that an electrically brooded chicken is usually ready for

the roost about two weeks sooner than one brooded by fuel heat, and is universally stronger and more vigorous.

Statistics show that an average of less than 50 per cent of the baby chicks placed under the many types



Interior of Brooding House, Baywood Poultry Farm, San Mateo, Cal

of brooders now in use are raised to the roosts, whereas actual tests made during the past eighteen months with a large number of electric brooders show that the proportion has been raised by their use to better than 85 per cent.

**Relative Costs of Operation.**—The following will give an idea of the relative costs of fuel and electric operation of brooders. The data are averaged from many figures secured in actual practice, and are based on an assumed outside temperature of 50° F.

**Relative Costs of Heat for Brooding**

| Method of Heating | Approximate Cost per 100 Chicks |
|---|---|
| Artificial 600 B.t.u. gas at $1.50 per 1000 cu. ft.. | $1.50 |
| Artificial 600 B.t.u. gas at $1.00 per 1000 cu. ft.. | 1.00 |
| Coal oil at 20c per gallon..... | 1.40 |
| Distillate at 8c per gallon..... | .45 |
| Distillate at 8c per gallon (blue flame burner).... | .15 |
| Electricity at 5c per kw.-hr..... | 1.00 |
| Electricity at 3c per kw.-hr..... | .60 |
| ..Electricity at 2c per kw.-hr..... | .40 |

It is apparent that, although electric energy may have to be purchased at a low rate to compete with fuel on the basis of actual cost of heat energy, the advantages accruing to the user of electrically heated apparatus will more than offset this added expense.

## CONCLUSIONS ON CHEMICAL AND ELECTRICAL CONDUCTIVITY.

In a recent investigation by Colin G. Fink it was established that in general we may conclude that the electrical conductivity of a substance is primarily dependent upon the shape and the distribution of the fundamental grains or particles composing the substance, and secondly, upon the presence or absence of thin films of secondary material enveloping these ultimate grains.

## SUGGESTED CHANGES AND EXTENSIONS OF U. S. WEATHER BUREAU SERVICE IN CALIFORNIA

The recent discussion in the American Society of Civil Engineers by Geo. S. Binckley and Chas. H. Lee has definitely culminated in the recommendation of the following changes and extensions of U. S. Weather Bureau Service in California:

1. That the law creating the United States Weather Bureau prescribes a wide range of duties, among which the gathering of precipitation records is but incidental.

2. That there is an urgent demand among engineers, throughout the United States, for more complete precipitation data throughout mountain drainage areas, to be used in conjunction with stream-flow data.

3. That the present fiscal regulations, organization, and administrative policy of the Weather Bureau are not adapted to the task of gathering complete precipitation data of the character desired by engineers.

4. That Congressional action should be sought, either to change the organization of the Weather Bureau, so that the desired result can be accomplished, or else that the duty of observing all factors affecting stream flow be turned over to the Water Resources Branch of the United States Geological Survey, with the appropriation of sufficient additional funds to carry on the work efficiently.

## DECAY IN BUILDINGS

Much discussion during the year of interest to men of the electrical industry occurred in the technical lumber press over the decay of wood in buildings. Several cases of bad failure were reported. Research was started by the Forest Service to determine the "killing points" in temperature and humidity of common fungi found in American buildings. These studies have already yielded data of considerable importance. It was found, for example, that with a temperature approximately 100° F., and a high humidity, the mycelia of certain fungi can be killed.

Field and laboratory studies indicate that much more care should be exercised in the selection of timber and in the construction of buildings to avoid conditions favorable to decay. A number of inspections of buildings which have given trouble on account of decay have shown that any one of the following causes may result in rapid deterioration of the building.

1. The use of green timber.
2. Allowing timber to get wet during construction.
3. Allowing the timber to absorb moisture after the building is finished, because of leaks or lack of ventilation.
4. The use of timbers containing too much sapwood.
5. The use of timbers which have already started to decay.

The avoidance of these conditions will, as a rule, prevent decay. In special cases, however, decay can only be prevented by preservative treatment. For this purpose, salts such as zinc chloride and sodium fluoride are better than creosote for buildings.

# MERCHANDISING ELECTRICAL ENERGY

*(The reservoir is each day proving itself of high economic value in lessening the costs of electric pumping supply. In Southern California earth basins constructed in light or sandy soils are rendered water tight by applying a coat of cement or lime plaster around the inside of the basin or else by spraying on the bottom and sides of the reservoir eighty to ninety per cent asphaltum base oil. Here are cost data of great value, which cover this recent phase of auxiliary supply for electric irrigation pumping. The author is commercial agent for the Southern Sierras Power Company at Riverside, California.—The Editor.)*

Completed Bank—Preparatory to Oiling

Interior Basin—Unoiled

## THE RESERVOIR

BY ROSS B. MATEER

As a sequence to the plowing up, several years ago, of a large acreage planted to alfalfa a series of observations conducted by a southern public utility showed, somewhat to the astonishment of the rancher, that the apparently high cost of water pumped per ton of alfalfa grown was not the result of the charge assessed per kilowatt hour of service rendered, but directly due to the quantity of water pumped and the high lift. In certain districts the unpumped water level ranged from sixty to seventy-five feet and the total head varied, when operating the large unit, from one hundred to one hundred and ten feet. This situation has now been overcome by the installation of small pumping plants, operating seven hundred or more hours each month, and delivering to an earth or cement reservoir a quantity of water approximately equal to one-half an inch of water per acre under cultivation, with a decreased cost of operation and the satisfactory irrigation of the soil by daylight, and with such quantities of water as is desired to draw from the storage basin, and which can be carried advantageously in the pipe line. The basins constructed and in service the past two years were of three general types; (1) those with embankments of the soil native to that district, (2) cement tanks, and (3) earth reservoirs lined with oil, or with a plaster of one-half or three-quarters of an inch in thickness.

**The Earth Reservoir** is located either upon the highest point of the acreage to be watered and as determined by a level, or in such a position that the small portion lying above the basin can be irrigated direct from the motor driven equipment, and is constructed by the rancher with his own stock or by contract. Those built according to specifications and by contract are generally superior, as much care is exercised (1) in the preparation of the site and (2) in constructing the banks to eliminate erosion.

Earth basins are completed in periods of from five to seven days with a four-horse team and Fresno. Practically all of the soil being carried over that previously dumped, insuring solid banks even prior to settling noted after the basin has been placed in service. The ordinary basin is scaled either by puddling with clay, adobe or manure. Care, however, being exercised to retain a sufficient quantity of water in the basin to at all times cover the bottom—eliminating fissures.

The expense of the basin varies somewhat according to the capacity. A basin with inside dimensions of 120x120x5 ft., clay sealed, and holding four hundred fifty thousand gallons, was constructed by contract for one hundred twenty-five dollars, while another, 150x150x5 ft., and with a capacity of seven hundred fifty thousand gallons, cost only one hundred forty seven dollars, though in each case the banks were fourteen feet at the base and three feet six inches at the top.

**Cement Tanks.**—Considered essential for the storage of water prior to the advent of the contracted oil sealed earth basin possess no advantage, except permanency perhaps commensurate with the extra first cost for materials, including reinforcing and labor. Gravel and cement must be purchased, forms built, and when cured the interior must be painted or treated to a bath of heavy oil to prevent seepage. Cement basins should be banked around the exterior with earth, providing support for the walls, which usually taper from a width of four inches at the top to six inches at the base. A circular basin four feet high and seventy-five

An Oil Spray Bath

Oiled Basin Showing Discharge Pipe

feet in diameter was constructed in 1915 at San Jacinto, at an expense of three hundred eighty dollars, and stores one hundred twenty-five thousand gallons of water. A small, direct connected plant, consisting of a five horsepower Crocker-Wheeler motor and a two inch horizontal Byron Jackson pump, was placed in a pit six by eight feet at a depth of forty feet, and delivers one hundred forty gallons of water per minute against a total head of with an input at the meter of five horsepower. The direct connected equipment, in conjunction with the basin, provides ample water for the thorough irrigation of twenty-three acres of alfalfa and four acres of garden truck at an expense of two hundred fifty dollars per year, payable in twelve equal monthly installments each of twenty dollars and eighty-five cents. The plant displaced was a three and one-half inch vertical pump belted to a fifteen horsepower Fairbanks-Morse engine.

**Earth Basins.**—Constructed in light or sandy soils are rendered water tight, first by applying a coat of cement or lime plaster around the inside of the basin, or second, by spraying on the bottom and sides of the reservoir eighty or ninety per cent of asphaltum base oil. The plaster lining should vary in thickness from one-half to one inch and only be applied after thoroughly tamping and settling the soil. Prior to plastering two inch mesh, chicken wire reinforcing can be advantageously spread over the bottom and sides of the basin, which can be plastered at an expense of six cents per square foot.

Storage basins with gravel or sand have been made water tight by spraying the interior of the basin with a heavy asphaltum base oil, applied under pressure and at the rate of one-half to three-quarters of a gallon per square yard of surface oiled. The oil is delivered by motor truck and in twenty-five barrel lots at a temperature of three hundred degrees or more and fluxes readily with the well-rolled surface. After oiling screenings are scattered over the surface, forming a flexible lining not affected by climatic or temperature conditions. Oil was purchased in 1916 at an average price of two dollars and fifty cents per barrel of forty-two gallons, though in accordance with the decree affecting all raw and refined products, oil has advanced to three dollars and fifty cents per barrel delivered within a radius of sixty miles of the pit. The basin shown in the figures required seventy-five barrels of oil for sealing, at an expense of one hundred sixty dollars, and an outlay of one hundred forty-seven dollars for construction. The gates, inlet and discharge pipes cost thirty-three dollars, or a total for the completed basin of three hundred fifty dollars. The basin has a capacity of eight hundred thousand gallons, and is operated in connection with a direct connected plant consisting of a 25 h.p., 440 volt, 3 phase Westinghouse motor and a special four inch Byron Jackson pump, delivering sixty-two inches of water against a head of eighty-five feet, with an input at the meter of twenty-three and one-half horsepower, or a plant efficiency of fifty-two and one-half per cent.

The direct connected equipment installed in a six by eight redwood pit, at a depth of sixty-nine feet, displaced a belt driven seven inch vertical pump and a sixty horsepower motor. Ninety acres of alfalfa and twenty acres of grain were advantageously flooded from the basin in 1916.

The oil required varies with the character of the soil, as was demonstrated by the construction of a basin 150x150x5 ft. Here gravel was encountered and one hundred and ten barrels of oil were sprayed on and worked into the bottom of the basin before rendering it water tight. The basin, erected at a cost of one hundred eighty dollars, and sealed at an expense of two hundred seventy-five dollars, is filled to a depth of four feet in thirty-four hours, at the rate of three hundred thirty-three gallons per minute, or thirty-seven inches delivered by a special four inch Byron Jackson direct connected equipment installed in a pit sixty-five feet deep, with an input at the meter of twelve horsepower. While only seventy acres of alfalfa were irrigated the past season, one hundred and ten acres can be thoroughly flooded merely by changing the runner in the pump at such a time as the demand for water increases.

As additional acreage is placed under cultivation in Southern California and the experience of the successful rancher is given consideration, it seems reasonable that the forty-five basins now in satisfactory service in the territory served by the Southern Sierras Power Company, and lasting monuments to the co-operation of utility and consumer, will be increased many fold.

# SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER

*(Alternating current motors are constantly displaying defects in their stator windings; the rapid growth in use of the electric range necessitates information on the replacing of switches; and the price at which goods are to be sold at a reasonable profit is a question of daily worry with the contractor and dealer. Here are timely discussions of these subjects by the power apparatus specialist of a well-known electrical supply house in San Francisco that should receive grateful consideration from the contractor and dealer perplexed by problems of this nature.—The Editor.)*

## ALTERNATING CURRENT MOTOR TROUBLES

### Defects in Stator Windings

In this article only those defects in the stator winding which particularly affect motors during the starting period will be enumerated. The discussion will apply equally well to squirrel-cage or slip-ring type motors since the same general form of winding is

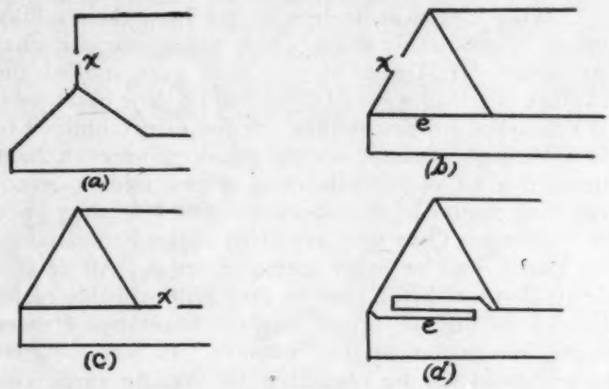



Fig. 1. (x denotes open circuit)

used in both types, whether the motor be designed for a two or three-phase circuit.

The most common winding faults are short-circuits, open-circuits and grounds. Once in a while a reversed phase will be found or perhaps only a few coils in a phase will be reversed. These faults are not often found in new machines as they are usually detected by the factory inspector or test department. Troubles due to wrong connections are easily found by inspection of the windings but the common troubles just given—short-circuits, open-circuits and grounds—are most always hidden from view and can only be detected by electrical tests.

An open circuit in one phase of a two-phase motor will leave the motor without starting torque. Hence, it will not start by itself. The same statement will apply with both phases open. When occurring in three-phase machines, the effect of an open circuit in one phase will depend entirely upon the way in which the stator is connected. With a Y-connected machine, Fig. 1 (a) this fault will leave the motor with single-phase excitation, therefore without starting torque. As in case of the two-phase machine, the motor will not start. In a delta-connected machine, the effect is different. An open circuit in one phase as shown by Fig. 1 (b) will give an open-circuited delta excited by three-phase current. The winding, in this condition, will produce a revolving magnetic field and accordingly develop a starting torque but the value of this torque will be much lower than that produced with all phases of the winding active. Should the starting torque of the motor in normal condition be just sufficient to start its load, the motor would probably not start at all. It would start, however, without load.

In a delta-connected machine, with one lead open between the terminal board and junction of the winding, as in Fig. 1 (c) the motor will receive only single-phase excitation and as before, will be without starting torque.

As just shown, single-phase excitation will not produce a starting torque in either a two or three-phase machine. However, if a motor excited in this manner is brought up to speed mechanically, it will continue to operate single-phase and will carry approximately 50 per cent of its normal full load. A three-phase motor operating in this manner will take at any load approximately 175 per cent of the corresponding three-phase current.

When a motor will not start unaided it is then well to give it some mechanical assistance. Should the rotor show a tendency to come up to speed in either direction it will indicate an open circuit in one phase of the winding or in one of the lead wires if a delta-connected stator. This condition is easily detected by reason of the peculiar humming noise due to the single-phase excitation of the windings.

A short-circuited coil will ordinarily not prevent starting but will cause excessive heating after the machines has been in operation a while. On the other hand, if a large torque is required from the motor and a number of coils happen to be short-circuited it is likely the motor will not start at all. Likewise, a three-phase motor with one phase of the stator reversed, will have a greatly reduced starting torque and will probably not start except without load. When the motor is running the stator currents will be badly unbalanced and will also produce a marked humming and buzzing noise. At this point note carefully that in this discussion a reversed phase refers to the actual reversing of one complete phase of the winding and not to simply reversing one phase by interchanging two of the external leads as would be done in order to reverse the direction of rotation of the motor. This will be clear by referring to Fig. 1 (d) which shows phase e in Fig. 1 (b) reversed.

Grounds in the stator may also give much trouble, depending upon their number and position in the winding. Two grounds in the same machine will often short-circuit a considerable portion of the whole winding and thereby prevent starting. If the frame of the machine is also grounded, as is now generally the case, then only a single ground in the winding may be suf-

ficient to make trouble. This is possible when the secondary circuits are grounded as a ground in the stator may act as a short-circuit across the supply service.

Additional articles on motor troubles will appear in later issues. The next one will deal with rotor or secondary circuit troubles.

## REPLACING SWITCHES ON RANGES

The question as to whether or not the heating unit in an electric range could be burned out by incorrectly connecting its controlling switch recently came up in connection with a complaint covering a unit which burned out almost immediately after a broken switch had been replaced. A little study will show that the connections, even though incorrectly made, could not possibly cause this trouble.

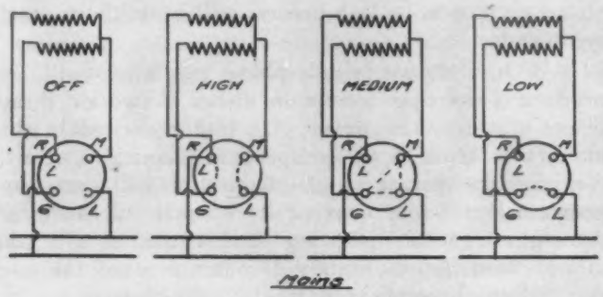



Fig. 2

The switches for this purpose are known as the series-parallel type and are arranged for an off position and for three heats, high, medium or low. These can also be supplied to effect the changes in the reverse manner, low, medium or high. The first scheme of operation seems most logical for range work as it allows the units to come up to full heat on the first step. Connections for the well known "Diamond H" switch used extensively for this service are shown in Fig. 2. which is taken from the manufacturers' catalog. From these diagrams it will be seen that in the high position both sections of the unit are in parallel across the mains—thus giving the maximum heat. Both sections are then working at normal voltage. In the next position one section only is burned at full heat, the other being short circuited by the switch contacts and carrying no current..

In the last or low position, both sections of the element are in series across the mains—thus giving minimum heat. This explanation shows that it is impossible to place more than normal voltage across any one section of the unit no matter how the switch is connected. Therefore, wrong connections could not cause the unit to be destroyed.

On the contrary, if the connections are not right the mains may be short-circuited. For example, assume that the switch instead of being connected as shown in the diagram is rotated 90 degrees to the right—then the right lead will connect to contact M instead of L, and so one. With this connection the mains will be short-circuited by the switch when it is thrown to the first closed position—that is to high heat. Rotating 180 degrees from the original position, however, does not produce a short circuit and will allow the units to heat up in one position, but rotating the switch another 90 degrees again produces a short-circuit. So it will be clear that caution must be taken in changing the switch. Mistakes will not be made if the position of the indicator on the switch is noted. It is customary to place the off position at the top.

When changing switches care must be taken not to alter the connections between the cutout and switch. Most ranges are wired for 3-wire service and when used in this way there is a possibility of double voltage being thrown across some of the units if the connections at the cutout are not correct. For the same reason, when changing a range from 2-wire to 3-wire service or vice versa the connections should always be carefully checked.

## SOMETHING ABOUT PRICES

Many electrical dealers do not keep their selling prices in get-at-able shape. You will appreciate what we mean, Mr. Dealer if you have ever studied the manner in which some of them handle their customers. When asked for prices they are frequently obliged to look through perhaps several catalogs or even hunt through a lot of miscellaneous letters, folders or advertising matter in an endeavor to find the latest price or discount. Then they are often obliged to estimate the parcel post or other carrier charges. All of this delay along with the excuses they will probably make for not having the prices at their finger tips creates a bad impression on the customer. In fact the customer could not be blamed if he became suspicious and wondered if the dealer really did know the prevailing market prices. Very often after such experiences the customer will want to shop around a bit and will ninety-nine out of one hundred times place his business elsewhere.

Now, Mr. Dealer, if you have been guilty of such practice it will pay you to give these points careful thought and to put your prices into more usable shape without delay. It is surprising how little time this requires, especially for the small store and how convenient it is to have all devices and materials properly tagged or marked with prices.

Begin first by marking all devices upon which there is an established advertised selling price, such as irons, toasters, sewing machine motors and the like. If price tags are furnished by the manufacturer always use them in preference to others. If not keep close at hand or on display literature or advertisements in which the selling prices are shown. Such evidences of standardized selling prices always have a convincing effect upon the customer.

Next arrange your prices on such material as dry batteries, flash lamp batteries, fuses, extension cords, repair parts for heating devices or such other material as is usually kept in bins or on shelves. An easy way to do this is to tack a card in the bin or in some convenient position. Be sure, however, to make the changes promptly upon advice of market changes. This is a scheme followed out extensively by hardware stores. It is convenient, inexpensive and easily kept up.

# WESTERN ELECTRICAL ASSOCIATION MEETINGS

*(Plans for the approaching convention of the Pacific Coast Section of N. E. L. A. are proceeding apace. From present indications this will be the largest and most enthusiastic assemblage of men of the electrical industry on the Pacific Coast thus far accomplished in the history of Western enterprise. The latest announcements of interest to the membership will be found in the following lines.—The Editor.)*

## PACIFIC COAST SECTION, THE LARGEST GEOGRAPHICAL SECTION OF N.E.L.A.

The Pacific Coast Section is already the largest geographical section of the National Electric Light Association and before the convention in April at least 1000 members will be enrolled. The Southern California Edison Company, alone, is responsible for 329 of these members and other companies are rapidly responding to the efforts of the energetic membership campaign.

Great enthusiasm and interest is being evinced in the first annual convention of the Section at Riverside, April 19-21. All convention papers and reports will be printed in advance in these columns and be distributed to the members prior to the meeting. This should insure first class discussion and will obviate the necessity for taking the time of the meeting to read the papers.

The convention committee, under the chairmanship of A. B. West, met at Los Angeles, March 17th to complete final arrangements for the convention.

The tentative program has already been printed in these columns. At the banquet on Friday evening, in addition to the report of the public policy committee, there will be addresses by Max Thelen, President of California Railroad Commission; John S. Mitchell of the Los Angeles Chamber of Commerce; O. B. Coldwell, representing Northwest Electric Light & Power Association, and H. M. Byllesby of Chicago.

The following circular, which is reproduced in miniature, has been sent to all members:

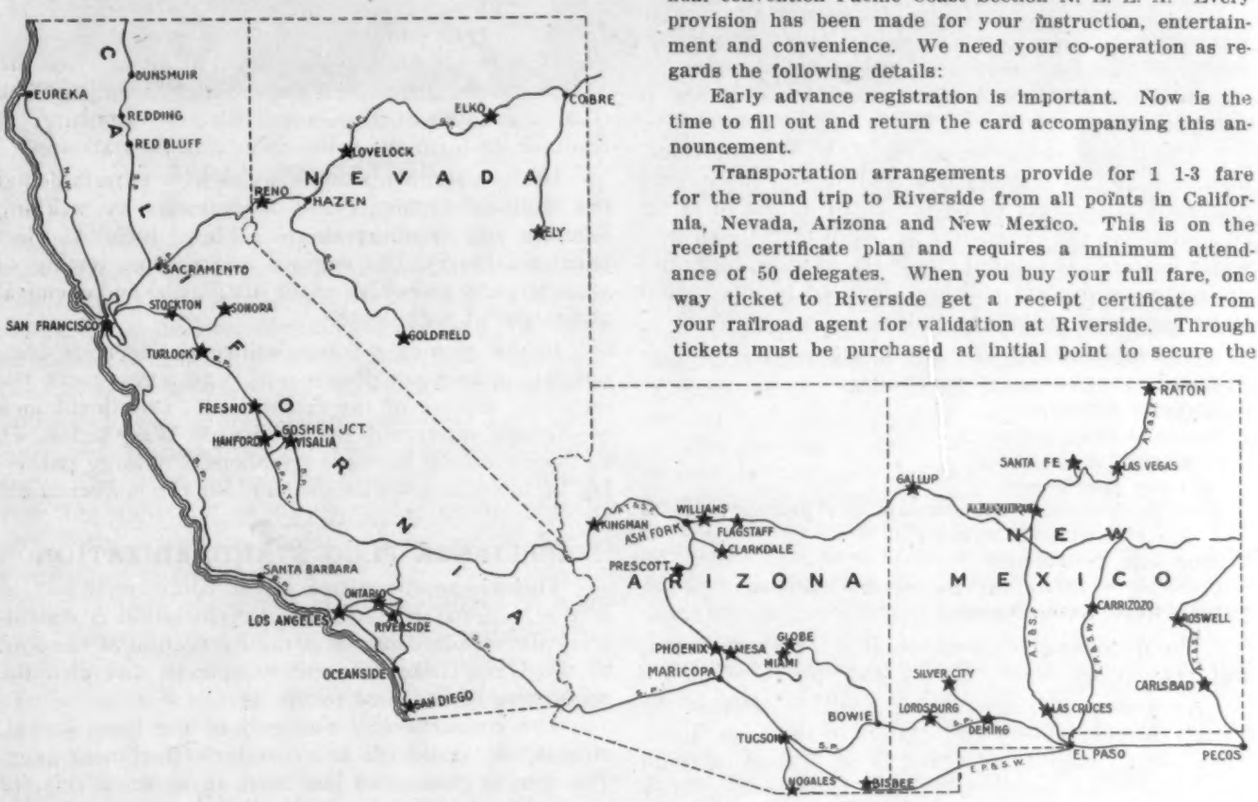
**All Aboard for Riverside Convention—Pacific Coast Section National Electric Light Association, April 19-21, 1917.**

You are invited and expected to attend the first annual convention Pacific Coast Section N. E. L. A. Every provision has been made for your instruction, entertainment and convenience. We need your co-operation as regards the following details:

Early advance registration is important. Now is the time to fill out and return the card accompanying this announcement.

Transportation arrangements provide for 1 1-3 fare for the round trip to Riverside from all points in California, Nevada, Arizona and New Mexico. This is on the receipt certificate plan and requires a minimum attendance of 50 delegates. When you buy your full fare, one way ticket to Riverside get a receipt certificate from your railroad agent for validation at Riverside. Through tickets must be purchased at initial point to secure the benefit of the one-third fare returning. In California tickets will be on sale for the going trip April 17-21, inclusive, and certificates will be honored for return April 19th to 23d inclusive. From points outside of California sales dates will be one day earlier.

A special car to the convention will leave San Francisco at 5 p. m. April 18th on the Sunset Limited, joining cars from Los Angeles on the morning of the 19th, to form a special train to Riverside. Other special trips will be announced subsequently.




Location of Class A Members, Pacific Coast Section, N. E. L. A.

**Special baggage tags will be supplied to all delegates registering in advance. These will accelerate delivery of trunks to guests' rooms.**

**Hotel accommodations have been reserved at the Glenwood Mission Inn, the convention headquarters, and at the Hotel Reynolds. The rates of the former are $5 per day with bath, $4 without, American plan. At the latter the rates are $1.50 per day and up, European plan. The Hotel Tetley also can accommodate fifty at $1 per day and up The Glenwood Mission Inn has facilities to care for all.**

**Please return attached post card at once.**

**CONVENTION COMMITTEE.**

The Engineering Committee, J. E. Woodbridge chairman, met at San Francisco on March 22d, and at Los Angeles on March 23d. As a result of these meetings the following reports will be presented for discussion:

**Standardization of Distribution Transformers;**
**Report of conferences with Engineers of California Railroad Commission on General Safety Order affecting Line Construction;**
**Suspension Insulators;**
**Standardization of Pin and Clevise Hardware for Suspension Insulators.**

E. B. Strong, master of transportation at San Francisco is trying to get up a special train to Riverside from San Francisco with every present assurance of success. At Los Angeles, E. R. Northmore is doing likewise.

The Commercial Committee, S. V. Walton, chairman, met at Los Angeles, March 17th and thoroughly discussed all reports to be presented at the meeting. In addition to the exhaustive report of tests on electric water heaters (as printed elsewhere in these columns) the following reports will be submitted for discussion at two sessions of the convention:

**Rates, Merchandising of Lamp Socket Devices.**
**Electric Cooking and Water-Heating.**
**Highway Lighting.**
**Industrial Electric Heating.**
**Commercial Organization.**
**Inductive Interference;**
**Fuse Protection of Transformers and Branch Lines in Rural Distributing Systems;**
**Joint Pole Construction;**
**Operation of Steam Turbine Standby Stations;**
**High Head Water Wheels.**

The Accounting Committee, B. F. Story chairman, will present its report Friday morning, April 20th.

An endeavor is now being made to interest the manufacturers, jobbers and dealers in the association. They are all eligible as Class D or E members and can derive much benefit from their membership. They will be particularly welcome at the convention.

## NEVADA SUB-SECTION N. E. L. A.

Nevada members of the Pacific Coast Section of the National Electric Light Association organiized an informal sub-section of the Association at Reno on March 10th, with Geo. A. Campbell, general manager of the Truckee River General Electric Company as chairman and A. H. Halloran, managing editor of the Journal of Electricity, as secretary. The meeting had been called by Dean J. G. Scrugham as one of the features of Engineers' Day at the University of Nevada.

Chas. A. Brown, superintendent of the Truckee River General Electric Company, presided at the organization meeting. Dean J. G. Scrugham told of the recent organization of the Pacific Coast Section and suggested that various representative men express their views on the matter. Joe Bean, superintendent of the Nevada Valley Power Company at Lovelock emphasized the advantage of frequent local meetings in solving local problems. L. W. Crehore, superintendent of the Fallon Electric & Water Company, told of the benefits he had derived from the standardization of construction and accounting methods by the N. E. L. A. C. S. Young, superintendent of the Lovelock Power Company, spoke in favor of regular meetings of the Nevada power men, as did likewise B. G. McBride, manager of the Elko-Lamoille Power Company at Elko. F. O. Broili of the Northwestern Electric Company, at Portland, illustrated the value of such meetings by the successful experience at Portland. A. H. Halloran, managing editor of the Journal of Electricity, gave full details of the organization and plans of the Pacific Coast Section N. E. L. A., and also the Society for Electrical Development. Brief remarks were also made by Geo. R. Murphy of the Electric Storage Battery Company and C. M. Le Count of the General Electric Company. A resultion to form the sub-section was then adopted.

In the afternoon many visitors were entertained at the engineering shops and laboratories by working exhibits and demonstrations. These included electrical machinery, gas engines and pumps, testing of materials and an exhibit of the distillation and chemical utilization of sage-brush.

In the evening a transcontinental telephone demonstration between Reno and Washington was the crowning feature of the celebration. Prominent men of Nevada conversed with those of Washington, D. C. over the long distance telephone. A large gathering of townspeople "listened in" on the conversation.

## APPLIANCE PLUG STANDARDIZATION

The wiring committee of the commercial section of the National Electric Light Association is considering the standardization of the connection of the cord to the lamp socket or wall receptacle, and also the connection of the cord to the device.

The connection of the cord to the lamp socket, etc., is the standardization of the attachment plug. The wiring committee has been at work on this for some time, but this is practically a separate question from the connection of the cord to the device. The latter question is the only one discussed in this notice, or to be discussed in the meeting noted below.

The wiring committee is so far firmly convinced of only one thing, which is that some time in the future there will be a standard form of connection so that a cord will fit the flat iron of different manufacturers and also will fit percolators, toasters, etc., of different manufacturers. It believes this development is as sure for the future as the present standardization of the Edison screw base for lamps.

# ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

*(Irrigation by spraying is new in the arid districts of the West, as is also the compilation of exact data concerning the necessary quantity of water required in the newly evolved industry of rice growing in California. Here are important digests on these two subjects of timely interest made by the author of this department who is a well-known irrigation specialist at the University of California. The pictures for rice growing have been furnished through the courtesy of Frank L. Adams, of the Department of Irrigation Investigations, U. S. Department of Agriculture.—The Editor.)*

Typical Installation for Spray Irrigation in Orange Groves, Near Porterville, Cal

## SPRAY IRRIGATION

The use of overhead spray systems of irrigation has been tried in a few instances for truck crops and citrus groves in California. Such methods of irrigation are as yet experimental, the advantages claimed are the more uniform distribution of water, reduction in labor cost in making furrows and irrigating, adaptation to rough or steep land, ability for plant roots in orchards to use the area between tree rows more effectively, and by using surface mulches to avoid cultivation. The disadvantages are the high cost of installation, the high cost of operation due to the pressure required to operate the spray system and the loss by evaporation in arid climates.

A bulletin descriptive of spray systems of irrigation as used in the East has been issued recently (Bulletin 495, U. S. Department of Agriculture, "Spray Irrigation," by Milo B. Williams). This bulletin describes the different methods used there with data regarding their equipment and operation. This bulletin states the cost of the field equipment of such systems may be as low as $50 per acre for portable outfits to $150 for stationary systems. To these figures must be added the cost of a main pipe line leading from the water supply to the fields and usually the cost of developing a water supply and installing a pumping plant. These items may bring the total cost to two or three times the figures given above for the distribution system alone. On the assumption of a first cost of $250 per acre, Mr. Williams estimates the annual cost of interest, depreciation, repairs and operation would be $51 per acre. It is recommended that a sufficient capacity to supply 1½ inches depth per week be provided in arid regions. Well water gives less difficulty from the clogging of the nozzles.

The overhead spray systems as used in citrus groves consist of lines of pipe supported on posts spaced about 50 ft. apart, or every other tree row. A single row of small holes fitted with small brass nozzles are fitted into the pipe. For citrus groves these pipes may be set on posts about 6 ft. high and 15 to 20 ft. apart, or they may be supported from a cable carried on high posts spaced from 100 to 200 ft. apart.

To generate a spray requires a pressure of 25 to 40 pounds on the nozzles in addition to conveying and elevating the water in the field. Owing to the greater cost of the main pipe lines used for such systems than of the concrete lines usual in the low pressure systems for furrow irrigation, Mr. Williams recommends using sizes which give friction losses of from 3 to 4 ft. per 100 ft. of line.

These general figures for eastern conditions furnish a basis for approximately the conditions which such systems must meet in California. The cost of installation will be as high as the figures given. If 600 ft. of pipe is required, with the nozzle lines 10 ft. above the ground and 30 pounds pressure at the nozzle line is maintained, a total pressure equal to a lift of from 90 to 100 ft. will be required, that is such systems represent cost of installation of $200 per acre with a condition of operation equivalent to a lift of 100 ft. above the lift required for other methods. Such conditions will limit the use of spray irrigation to those particular conditions and crops where the returns will justify the expense. These conditions may occur in California for intensive truck or nursery practice and possibly for citrus fruits, although their use for the latter crop is questionable.

Crowder for Building Levees | Threshing Rice | Harvesting Rice

## DUTY OF WATER FOR RICE GROWING

Approximately 64,000 acres of rice were irrigated in the Sacramento Valley in 1916, as shown in a report of measurements of duty of water for rice in the Sacramento Valley by Ralph D. Robinson, irrigation engineer, recently issued by the California State Water Commission. Of this area approximately 29,500 acres were irrigated from the Sacramento River, 24,000 acres from the Feather River, 8800 acres from minor streams and 1700 acres with water pumped from wells. The first commercial crop of rice in California was grown in 1912 on 1400 acres. The area in 1916 was over twice that planted in 1915.

Measurements were made of the water used on 18 representative fields located on both sides of the valley. The area of these fields varied from 14 to 1100 acres, the total area being 3300 acres. Ten different soil types were represented.

Where water was wasted or drained from a field an attempt was made to measure or estimate the quantity removed. In many cases there was considerable seepage through the outside levees into adjacent sloughs which could not be measured and again in some instances the levees were not sufficiently high to prevent water flowing over the tops into neighboring fields or roads. Probably 1/3 to 1/2 of the water applied to some fields was lost in this manner.

Another factor which enters into the use of water is the depth to ground water. Where the water table was about one foot below the surface as in the case of fields near Biggs, the amount applied was much less than in fields near Willows or Marysville, where the water table was 3 to 12 ft. below the surface. Aside from the proximity to sloughs, depth to water table and manner of irrigating rice, the character of the soil and the preparation of the land play an important part in the use of water.

The minimum amount of water used on any field was 4.27 acre feet per acre on the Adams field on Stockton clay adobe near Biggs. The maximum net amount used was 14.83 acre feet per acre on the Johnson No. 1 field on Willows loam and Willows clay adobe near Willows. The average depth applied to the 18 fields was 8.23 feet exclusive of waste.

None of the canal companies in Sacramento Valley, with the exception of the Yolo Water & Power Company, which charges $1.50 per acre foot for water, have as yet sold water on an acre foot basis.

The Sacramento Valley West Side Canal Company, by authority of the Railroad Commission, charged $7 per acre for rice irrigation. For this charge the water user was entitled to 5 acre feet of water per acre and additional amounts were to be charged for at the rate of $1.50 per acre foot. However, no cases are known where charges were made on an acre foot basis. The Sutter-Butte Canal Company has furnished water to lands having water rights at $5 per acre. Recent contracts made by the company are on the basis of $7 per acre with reimbursements to the water user for the construction of ditches and procuring of rights of way, providing water has been used for more than two successive years. The amount of water called for in their contracts is on the basis of 1 cubic foot per second for each 53 1/3 acres.

The irrigation season for rice in Sacramento Valley is divided into two periods. In the first period the rice is irrigated from 4 to 8 times without having water stand on the field. When the rice is about 6 inches high, which is from about 4 to 6 weeks after planting, the fields are kept submerged about 6 inches deep until the rice is matured. When the heads are turned down and properly filled, the water is removed from the field to permit of harvesting. With one exception, all of the fields studied in 1916 were planted to Wataribune rice, which is the most widely planted variety in California. The total length of the irrigation season varied from 155 to 189 days. A variety of Japanese rice known locally as California Pearl on the Dodge Rice Company tract required only 147 days to mature.

Rice fields are laid off in contour checks ranging from 2 to 5 or more acres in extent. A few years ago the levees were made with Fresno scrapers, but the common practice now is to throw them up with a large checker or crowder drawn by a tractor.

The Sutter-Butte Canal Company, which takes its supply from the Feather River about 10 miles above Gridley, served the largest area of rice, amounting to 17,000 acres. The Western Coal Company, which heads on the Feather River shortly above the Sutter-Butte Canal, served 5500 acres. The lands served under these two systems are classified by the Bureau of Soils as Stockton clay adobe. The Sacramento Valley West Side Canal supplied water to 8500 acres in Glenn and Colusa counties. A striking feature here was that considerable land locally known as "goose land" and which had heretofore been unutilized except for scanty pasture, was planted to rice.

The average gross depth of water used prior to submergence is 1.78 ft. and during submergence 7.92 ft. on 15 fields for which the detail is given. The average measured waste from the 18 fields is 1.02 acre feet per acre. The average area served per second foot of water during the period of submergence is 40 acres, varying from 18 to 70 acres for the diifferent fields. Of the 18 fields only 3 that were investigated received less than 5 acre feet and 5 exceeded 10 acre feet per acre.

# FUEL OIL AND STEAM ENGINEERING

*(Steam tables are to fuel oil and steam engineering practice what the letters of the alphabet are to English composition. They are the working tools whereby the engineer is enabled to make quick and accurate expression of facts pertaining to power plant economy. Here is a discussion of the well-known Marks & Davis steam tables that should enable the student in fuel oil and steam engineering study to make use of this valuable weapon in computation of test data.—The Editor.)*

## THE STEAM TABLES IN FUEL OIL PRACTICE

BY ROBERT SIBLEY

The Book of Steam Tables

IT has already been shown that since no simple mathematical laws have as yet been devised to express the temperature, pressure, latent heat, heat of liquid and other fundamental properties of steam and water that are absolutely necessary in the solution of steam engineering problems, we must resort to carefully compiled steam tables.

Practically all the research and scientific investigation along the lines of pure steam engineering of the last half century have been devoted to the more complete establishment of some of the fundamental constants involved in the steam tables.

The three most important of these are the zero point of the absolute temperature scale, the proper value for a constant employed in the conversion of mechanical energy into heat energy, and the exact determination of the heat required to evaporate one pound of water from 212° F. into dry saturated steam at 212° F.

Since these values are continually found by more careful and exacting experimental work to be slightly different than formerly held, we find that the steam tables of recent publication are different than those of former years.

**The Steam Tables as Adopted in this Discussion.**—The Steam Tables and Diagrams as computed by Marks and Davis and published by Longmans, Green & Company are today universally recognized and are adopted as the standard compilation for the problems cited in this discussion.

In the rear of these steam tables an interesting discussion of the methods employed by these investigators in arriving at the three fundamental constants mentioned above is given. The result of these investigations shows that the absolute zero is to be taken at 459.6° F., the mechanical equivalent of heat at 777.5, and the latent heat of steam at 212° F. to be 970.4 B.t.u.

**Recapitulation of Fundamental Evaluations.**—These three constants are so important that they should be memorized and for emphasis let us recapitulate their exact interpretation.

The absolute zero is now found to be a point situated at 459.6° F. below the zero point on the Fahrenheit scale or 491.6° F. below the freezing point of water. At such a temperature it is supposed to be impossible to further draw off heat from any substance for at this temperature the heat storage is supposed to be absolutely exhausted.

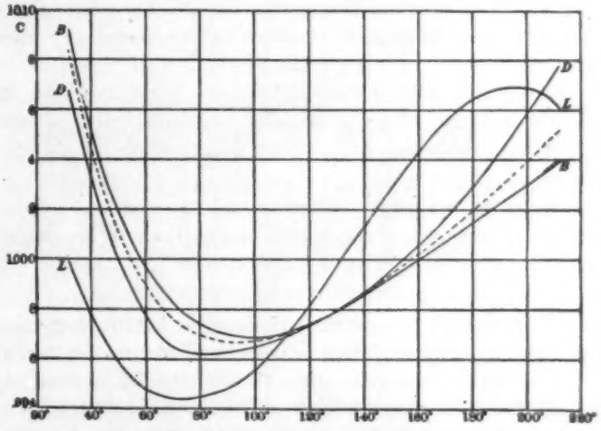
The mechanical equivalent of heat as given above means that the energy represented by one B.t.u. or British thermal unit of heat is equivalent to 777.5 ft. lb. of mechanical energy. Or if one pound of crude petroleum contains 18,500 B.t.u., it possesses as stated in a previous chapter, sufficient energy to raise a human being weighing 175 lb. a vertical upward distance of over 18 miles.

The latent heat of steam at 212° F. and atmospheric pressure means that the quantity of heat necessary to evaporate one pound of water at 212° F. into dry saturated steam at 212° F. is found experimentally to be 970.4 B.t.u.

**Analysis of a Typical Page of Steam Tables.**—Let us now proceed to analyze a page of Marks & Davis' steam tables, column by column. The illustration as given is found on page 12 of this compilation and we shall follow across the page the line corresponding to a temperature of 231°F.

**Temperatures in Fahrenheit Units.**—Since all steam engineering computation is based on temperatures represented in the Fahrenheit scale instead of the Centigrade system, the temperatures are here listed in the Fahrenheit units.

**Pressures in Absolute Notation.**—This column means that the pressures here given represent the pressure in pounds per sq. in. at which water will boil when the temperature is that as listed in the first column. Further on in the steam tables an exactly similar table may be found to the one cited except in




Marks & Davis Method of Collating Data for Specific Heat of Water from Three Noted Investigators

this latter instance the pressures are made to vary pound by pound and the corresponding boiling temperature of water given.

In this instance, then, we read that a pressure of 21.16 lb. per sq. in. is necessary in order to make water boil or begin the formation of steam at 231° F. This pressure, by the way, is in absolute units and would not be the pressure read on the steam gage of a boiler room. Since the steam gage indicates pressures above the atmosphere, one must subtract from this reading in the steam tables the atmospheric pressure of the day in order to find the proper gage pressure. Thus, in this instance, if the atmospheric pressure of the day be 14.7 lb. per sq. in., a steam gage in a boiler room would read 6.46 lb. per sq. in., when the water in the boiler is 231° F.

**Table 1: Temperatures**

| Temp. Fahr. | Pressure lbs. | Pressure Atmos° | Sp. Vol. cu. ft. per lb. | Density lbs. per cu. ft. | Heat of the liquid | Latent heat of evap. | Total heat of steam | Internal Energy B.t.u. Evap. | Internal Energy B.t.u. Steam | Entropy Water | Entropy Evap. | Entropy Steam | Temp. Fahr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| t | p | — | v or s | 1/v | h or q | L or r | H | I or ρ | E | n or ø | L/T or r/T | N or ϕ | t |
| 230° | 20.77 | 1.413 | 19.39 | 0.0516 | 198.2 | 958.7 | 1156.9 | 884.3 | 1082.4 | 0.3384 | 1.3905 | 1.7289 | 230° |
| 231 | 21.16 | 1.440 | 19.05 | 0.0525 | 199.2 | 958.1 | 1157.2 | 883.6 | 1082.7 | 0.3399 | 1.3875 | 1.7274 | 231 |
| 232 | 21.56 | 1.467 | 18.72 | 0.0534 | 200.2 | 957.4 | 1157.6 | 882.8 | 1083.0 | 0.3414 | 1.3844 | 1.7258 | 232 |
| 233 | 21.96 | 1.494 | 18.40 | 0.0543 | 201.2 | 956.7 | 1158.0 | 882.1 | 1083.2 | 0.3429 | 1.3814 | 1.7243 | 233 |
| 234 | 22.37 | 1.522 | 18.09 | 0.0553 | 202.2 | 956.1 | 1158.3 | 881.3 | 1083.5 | 0.3443 | 1.3784 | 1.7227 | 234 |
| 235° | 22.79 | 1.550 | 17.78 | 0.0562 | 203.2 | 955.4 | 1158.7 | 880.6 | 1083.8 | 0.3458 | 1.3754 | 1.7212 | 235° |
| 236 | 23.21 | 1.579 | 17.47 | 0.0572 | 204.2 | 954.8 | 1159.0 | 879.8 | 1084.0 | 0.3472 | 1.3725 | 1.7197 | 236 |
| 237 | 23.64 | 1.609 | 17.17 | 0.0582 | 205.3 | 954.1 | 1159.4 | 879.1 | 1084.3 | 0.3487 | 1.3695 | 1.7182 | 237 |
| 238 | 24.08 | 1.638 | 16.88 | 0.0592 | 206.3 | 953.4 | 1159.7 | 878.3 | 1084.5 | 0.3501 | 1.3666 | 1.7167 | 238 |
| 239 | 24.52 | 1.668 | 16.60 | 0.0602 | 207.3 | 952.8 | 1160.0 | 877.6 | 1084.8 | 0.3516 | 1.3636 | 1.7152 | 239 |
| 240° | 24.97 | 1.699 | 16.32 | 0.0613 | 208.3 | 952.1 | 1160.4 | 876.8 | 1085.0 | 0.3531 | 1.3607 | 1.7138 | 240° |
| 241 | 25.42 | 1.730 | 16.05 | 0.0623 | 209.3 | 951.4 | 1160.7 | 876.1 | 1085.3 | 0.3546 | 1.3578 | 1.7124 | 241 |
| 242 | 25.88 | 1.761 | 15.78 | 0.0634 | 210.3 | 950.7 | 1161.1 | 875.3 | 1085.6 | 0.3560 | 1.3550 | 1.7110 | 242 |
| 243 | 26.35 | 1.793 | 15.52 | 0.0644 | 211.4 | 950.1 | 1161.4 | 874.6 | 1085.8 | 0.3575 | 1.3521 | 1.7096 | 243 |
| 244 | 26.83 | 1.826 | 15.26 | 0.0655 | 212.4 | 949.4 | 1161.8 | 873.8 | 1086.1 | 0.3589 | 1.3493 | 1.7082 | 244 |

A Typical Page from the Steam Tables

**Pressures in Atmospheres.**—In many engineering computations pressures are given as so many atmospheres instead of pounds per square inch. The pressure of the standard atmosphere is usually taken as 14.7 lb. per sq. in. but for very exact work it is more accurately 14.696 lb. per sq. in. Hence this column is computed by dividing each item in the preceding column by 14.696, which in this instance is found to be 1.440 atmospheres.

When, however, the reading is below that of ordinary atmospheric pressure, such values are often desired in inches of mercury since vacuum pressures for the condenser are given in such units. This particular column is there found by dividing the corresponding line in the preceding pressure column by the number of inches of mercury equivalent to one pound pressure per square inch. It is to be remembered that this does not even yet give the reading in inches of vacuum. Pressures in absolute inches of mercury, and inches of vacuum cause seemingly endless confusion. A complete discussion of this feature was taken up under the chapter on pressures and its careful review is emphatically recommended if any unsettled question still exists in the mind of the reader.

**Specific Volume.**—The cubic feet occupied by one pound of dry saturated steam at a given temperature and pressure is known as the specific volume of the steam for that temperature and pressure.

This is a factor often necessary in steam engineering computations. Yet no known means has ever been invented whereby this factor can be accurately ascertained by experiment. The task is indeed one that involves such difficulties as to make its determination by experiment practically impossible. The science of higher mathematics has come to the rescue and here is indeed an instance where purely theoretical deductions have brought about a practical solution of an otherwise unsolvable problem in steam engineering

This relationship involves the latent heat of evaporation **L**; the absolute temperature **T** at which the saturated steam is formed; the ratio of the increase in pressure $\Delta p$ to the increase in temperature $\Delta t$ of boiling points taken immediately below the temperature under consideration and immediately above it; the specific volume of the steam **v** that is found, which of course, is the unknown value we are desirous of computing; and the specific volume of a space occupied by one pound of water $v_1$ immediately before its conversion into steam. Algebraically the relationship is expressed thus:

$$L = T \left(\frac{\Delta p}{\Delta t}\right) (v - v_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

From the steam tables we will take our values for $\Delta p$ and $\Delta t$ immediately below corresponding to 230° F. and immediately above corresponding to 232°F. Hence

$$\Delta t = (232 - 230) = 2.$$
$$\Delta p = (21.56 - 20.77)\ 144 = 0.79 \times 144 = 114.$$
$$T = 231 + 459.6 = 690.6.$$
$$L = 958.1 \times 777.5.$$
$$v_1 = .016 \text{ cu. ft.}$$

Substituting, we have

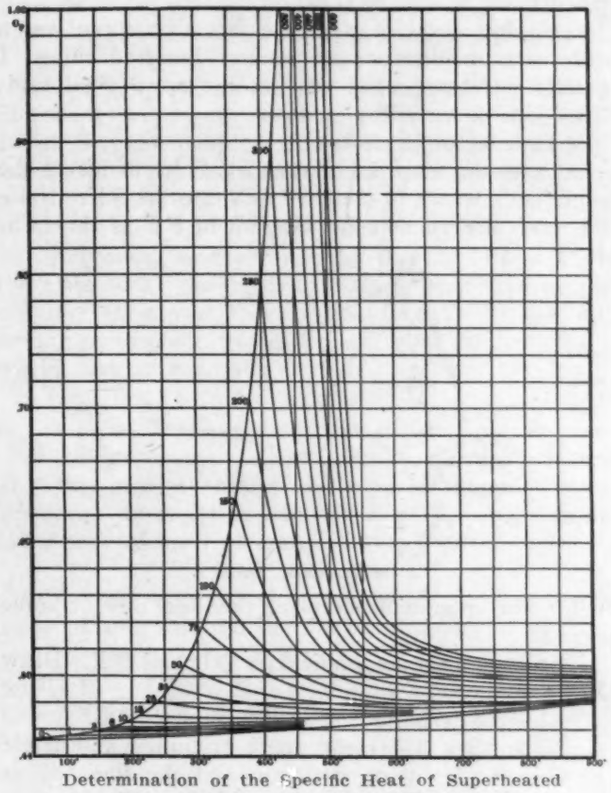
$$958.1 \times 777.5 = 690.6 \left(\frac{114}{2}\right) (v - .016)$$

$$\therefore v = 18.98$$

The value in the table is 19.05 which is seen to be about one-third of one per cent in error. This difference is probably due to the fact that decimals neglected in computation were made use of by the compiler of the steam tables, and then too the small pressure and temperature variations were probably taken nearer together than is possible in the data actually set forth in the steam tables.

**Specific Density.**—The weight in fractions of a pound of one cubic foot of dry saturated steam is known as its specific density.

It is evident that if one pound of steam occupies 19.05 cu. ft. as taken from the previous column, then 1 cu. ft. of steam would weigh 1/19.05 of a pound which is 0.0525 lb. Hence this column is computed in



Determination of the Specific Heat of Superheated Steam from Investigations of Knoblauch

each case by taking the reciprocal of the data given in the preceding column.

**The Heat of Liquid.**—This is one of the most important columns necessary in steam engineering practice. Since the heat of liquid technically means the quantity of heat necessary to raise one pound of water from 32° F. to the temperature under consideration, it is evident that by experimental data as given in this column it has been found that to raise one pound of water from 32° F. to 231° F., 199.1 B.t.u. are necessary to be applied from an outside source.

**The Latent Heat of Evaporation.**—Data for the latent heat of evaporation has been determined by careful experimental means. It is by definition the quantity of heat necessary to convert one pound of water at the temperature and pressure indicated into dry saturated steam at the same temperature and pressure. In this instance it is seen that to convert one pound of water at 231° F. into dry saturated steam at 231° F., 958.1 B.t.u. are necessary to be applied from an outside source.

**Total Heat of Dry Saturated Steam.**—The total quantity of heat required to raise the temperature of one pound of water at 32° F. to the temperature at which dry saturated steam may exist under the pressure excited in the particular instance, added to the quantity of heat then necessary to convert this water completely into dry saturated steam is known as the total heat of dry saturated steam. Numerically speaking, it is seen that this column is at once obtained by adding the heat of liquid and the latent heat of evaporation. In a word, this column is the sum of the two preceding columns. Thus

$$H_{231} = h_{231} + L_{231} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\therefore H_{231} = 199.1 + 958.1 = 1157.2.$$

**Internal and External Work.**—One wonders where the heat disappears when it is being continually applied to water at the boiling point and yet the temperature of the water or steam does not increase.

Upon careful investigation it is found that it disappears first in an internal absorption due to intermolecular rearrangement as water passes into steam which thereby stores up a considerable quantity of energy to be given out again when the steam is condensed back into water. The energy that disappears in this manner is known as energy necessary to perform internal work.

On the other hand in the generation of steam from water the volume is vastly increased. The pushing back against external pressure to make room for such an increased volume performs external work. So that the energy applied in steam generation which goes toward latent heat of evaporation may be divided into two classifications, known as external and internal work.

No one has as yet found a method of directly measuring internal work. We may, however, measure external work or even compute it and then by subtraction from total energy absorbed arrive at a value for internal work.

In a former chapter on gases it was shown that the external work accomplished by a gas expanding under constant temperature and pressure is computed universally by subtracting the initial volume from the final volume and then multiplying this result by the pressure. Thus

$$\text{Ext. Work} = p\,(v - v_1)$$

To convert this into B.t.u., we have

$$\text{Ext. Energy} = \frac{p\,(v - v_1)}{777.5} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

From the tables it is seen that in this instance $p = 21.16 \times 144$, $v = 19.05$, $v_1 = .016$.

$$\therefore \text{Ext. Energy} = 21.16 \times 144\ (19.05 - .016) = 74.6 \text{ B.t.u.}$$

$$\therefore \text{Internal Energy} = 958.1 - 74.6 = 883.5 \text{ B.t.u.}$$

**Entropy of Water.**—In certain advanced problems in steam engineering, engineers and physicists have found it convenient to invent fictitious qualities of steam. While many have endeavored to give a physical interpretation of entropy, perhaps it is clearer for the student to consider it as merely a mathematical fiction which, however, often becomes extremely useful for the representation of steam engineering problems and indeed assists wonderfully in their solution.

On this assumption, entropy may be defined as such a quantity that when plotted against absolute temperatures the area under the curve connecting all

such points will numerically represent the amount of heat supplied to one pound of matter in order to accomplish the indicated change in temperature. Thus in the instance at hand if one should plot a curve with ordinates representing absolute temperatures and with abscissas representing the entropy for each corresponding temperature, the area under this curve would be exactly 199.1 units. For it takes 199.1 units of heat energy to raise one pound of water from 32° F. to 231° F. or on the absolute scale from 491.6° F. to 690.6° F.

By analysis in higher mathematics it is found that entropy of water may be quite closely computed by the formula

$$\theta = \log_e \frac{T_2}{T_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Wherein $\theta$ is the entropy of water, $T_2$ the absolute temperature at the end of the heat application and $T_1$, the absolute temperature at the beginning which is usually taken at the melting point of ice or 491.6° F. on the absolute scale. Thus in this instance

$$\theta = \log_e \frac{T_2}{T_1} = \log_e \left(\frac{231 + 459.6}{32 + 459.6}\right)$$

$$= 2.306 \log_{10} \frac{(690.6)}{(491.6)} = .3399.$$

The value in the steam tables were arrived at by a slightly more accurate process than this by taking into account the fact that the specific heat of water is not constant as heat is added.

**The Entropy of Evaporation.**—Since the temperature remains constant during the evaporation of water into dry saturated steam, it is evident that the entropy curve in this case would simply be a rectangle as shown in the illustration wherein one dimension is of length **T** and the area swept off is of **L** units. Hence, the entropy for heat of evaporation is evidently

$$\text{Entropy of evaporation} = \frac{L}{T} \quad \ldots\ldots\ldots\ldots (5)$$

or in this instance,

$$\text{Entropy of evaporation} = \frac{958.1}{231 + 459.6}$$

$$= 1.3875$$

**Total Entropy.**—The sum of the entropy value for water and for heat of evaporation is called the total entropy of dry saturated steam. This is evidently arrived at numerically by adding together the two preceding columns. Thus, total entropy = entropy of water + entropy of evaporation..... (6)

$\therefore$ Total entropy = 0.3399 + 1.3875 = 1.7274.

**Tables for Superheated Steam.**—In later pages of the steam tables are to be found data relative to superheated steam. As a subsequent chapter will deal largely with superheated steam computations, we shall delay the consideration of superheated steam tables until the reader has been more thoroughly grounded in other fundamental computations of dry saturated steam.

## OZONE FOR THE CHILDREN—V. OR ENGINEERING TWISTERS RETOLD

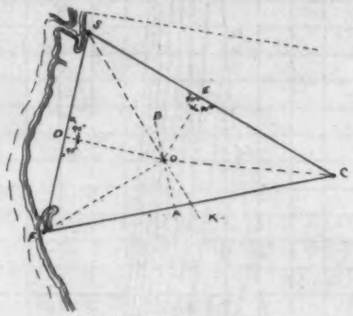
Emphasis on accuracy of diagramatic proportion can not be too strongly made. Here is a deduction that is absolutely geometrically correct, based on the diagram as shown.

Said he: "Did you ever realize that the distance from Seattle to San Francisco is the same as the distance from Seattle to Chicago?

Having knowledge of the fact that there was a difference in distance of several hundred miles, I quietly wondered what was coming now. So I said: "Can you prove it?"

Thus he proceeded:

Upon the map designated S C F let us bisect the angle at S, which is sketched as shown at S K. Upon F C erect a perpendicular bisector of F C as shown at



A Diagramatic Fallacy

A B. This line will intersect the line S K at some point O.

From O drop perpendiculars O D and O E. Draw lines O F and O C.

Now the triangle S O D = triangle S O E.

Since they are right angle triangles and angle O S D = O S E by construction and the line O S is common to both triangles.

Hence S D = S E, for they are homologous sides of equal triangles.

Also the triangle O D F = triangle O E C. Since they are also right angle triangles and since O D = E O (being homologous sides of equal triangles just proved above), and O F = O C, being lines connecting the extremities of the perpendicular bisector from point O on this bisector.

$\therefore$ D F = E C (being homologous sides of equal triangles.)

Adding we have

S D + D F = S E + E C

or S F = S C.

Hence the distance from Seattle to San Francisco must equal the distance from Seattle to Chicago.

## SAFETY NETS FOR FALLING WORKMEN

The Safety Department of the Industrial Accident Commission has been responsible for the introduction of safety nets in San Francisco for buildings under the course of construction. These nets are used in some of the large Eastern cities and there are European countries that require a similar safety precaution. It is intended to secure the co-operation of California's building contractors in order that the safety nets may come into general use.

# SPARKS—Current Facts, Figures and Fancy

*(Electro-chemistry continues to arouse interest of engineers in the West. Vast preparation is being made in certain of the universities of this section of the country to properly undertake research work that may forward immeasurably the electro-chemical possibilites of the undeveloped resources of this section. Among the "sparks" given below may be gleaned further facts regarding this activity in addition to other facts, figures and fancy of interest to the engineer.—The Editor.)*

Fuel briquets are on the increase in the United States. Over a quarter of a million tons were produced in 1916 having a value of a million and one-half dollars which represent an increase in valuation of forty per cent over 1915.

* * *

According to the Financial World of New York there are today provinces in Mexico where the people are free from war to carry on their industries and among themselves, though cut off from the rest of the world, they appear to be thriving.

* * *

A piece of Douglas fir, sixteen feet long and sixteen by eight inches in cross section, stood a pressure of eighty-eight thousand four hundred pounds before breaking, at the test conducted in the engineering laboratory of the University of Washington.

* * *

January established a new record for number of ships passing through the Panama Canal. In all there were seven hundred thirty-two, a net increase of ninety-two over the best preceding month. The aggregate net tonnage exceeded five hundred and fifty thousand tons.

* * *

That the famous "Japan Current," long credited with affecting the climate of California, apparently does not reach California at all and has no effect whatever on its climate, is one conclusion resulting from Mr. McEwen's studies of the currents and sea conditions off the coast of California.

* * *

How greatly sea-water may vary in temperature within a short distance is shown by the fact that with water at the harbor-mouth of San Diego Bay at a temperature of 66 degrees F., the shallow waters in the bay off National City registered 80 degrees F. A curious fact is that a difference of several degrees has frequently been observed in the temperature of the water in samples taken not sixty feet apart near the Coronado Islands, for instance.

* * *

These submarine depths are very different from surface waters. Two hundred feet down below the ocean surface there is scarcely one per cent as much light as there is three feet below the surface. Thirteen or fourteen hundred feet below the surface the temperature, summer or winter, is about 44 degrees F. and stays about the same the year round, while on the surface, a few miles west of the Coronado Islands, for instance, the water varies in mean monthly temperature from a minimum of 57 up to 68 degrees F.

From three thousand nail-pulling tests conducted by the Forest Service, it appears that the holding power of nails has a definite relationship to the density of the wood, and that there is practically no difference in strength between a solid beam and a wooden beam of the same dimensions made of two planks nailed together.

* * *

Only ten per cent of the average man's income goes for transportation—but transportation is regulated in the public's interest. Forty per cent of the average man's income is spent for food but the state takes no adequate steps to see to it that the amount of food is sufficient or that it is supplied upon terms fair alike to the consumer and the producer. It seems as if utility regulation may be vastly extended in the near future.

* * *

Each day brings more forcefully to mind the necessity of urging consumers to be more careful in the use of electric apparatus. Recently an electric pressing iron upon which a certificate of approval had not been issued, was left in service on the premises at the close of the day and the resulting fire caused a loss of thirteen hundred dollars. Another similar instance of recent record cost a medical institution thirty-five thousand dollars.

* * *

Laboratories for technical and electro-chemistry are especially important features of the new quarter of a million dollar chemistry building at the University of California, in recognition of the fact that one of the greatest of the opportunities which awaits California is the development of the chemical industries. With California's enormous supply of moutain water power and of cheap fuel, with vast stores of raw materials of infinite variety, and with the ocean at hand for export, there are illimitable possibilities in the development of chemical manufactures.

* * *

The Forest Service in co-operation with an American manufacturer of dyes in further establishing the use of osage orange was vigorously pushed during the year. This wood is now being commercially used for the manufacture of dyes, the total annual production being worth three-quarters of a million dollars. Carloads of osage orange wood are now being shipped from Oklahoma to eastern extract plants. Men in California and other Western commonwealths interested in getting into this industry should take the matter up with the Forest Service at Madison, Wisconsin.

# JOURNAL OF ELECTRICITY

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### The Engineer and War Profits

One of the striking features of the present war situation is the pervading spirit among engineers and technical men generally to be of assistance to the country should occasion require and to give this assistance devoid of monetary consideration that could in any measurable way represent the value of the service rendered.

One instance of this kind may be noted in the case of Thomas A. Edison, the famous inventor who now serves as chairman of the Naval Consulting Board. Another instance is that of A. M. Hunt, so long connected with this Journal and its activities and for so many years a well-known engineering figure in the West, who is also with Mr. Edison.

Daily observation is bringing to light countless other instances throughout the West where engineers are either now actually engaged in loyal patriotic service or else are standing close to the shore ready to answer the call at any moment.

The growth of sentiment against war profits among public spirited engineering manufacturing concerns is also to be noted with entire satisfaction by citizens generally. The doctrine that all profits should be taken out of war if hostilities become inevitable, and the assertion of the doctrine of state above individual rights find strong endorsement in every quarter of the West.

The task ahead calls for whole-hearted patriotism from all interests, and after serious quiet consideration should the call be heard, the engineer of the West will stand ready to meet with un-selfed service every emergency that may arise.

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### The Human Side of Efficiency

Much has been said of late relative to time study and the most efficient way of performing a given task. In practically all of these investigations an attempt has been made to fit the man to the job in the most efficient manner possible. Would it not prove far wiser to reverse this study procedure an endeavor to fit the job to the man? In other words, speaking from the broadest view point possible, would it not in the long run prove far more efficient to devote exhaustive investigation into the characteristics of the man and then endeavor to fit the job to these characteristics, rather than attempt to take the inanimate job and straddle the man to it?

Such investigators as Minor Chipman who recently gave an address before the San Francisco Engineers' Club on Efficiency, show conclusively by their reasoning that the human element does enter and furthermore that efficiency study, devoid of consideration of the human element in the workman, must in the long run prove to be a failure.

This leads us to the conclusion that the one hundred per cent efficient man is not the one who gives out quantitatively in labor upon a given job the same amount of effort as is put into the job similar to our mechanical method of rating machines, but rather is that man one hundred per cent efficient who works harmoniously and perfectly upon the job to which he is best suited, independent of the comparative accomplishment of other workers.

At first sight such reasoning seems too much in accord with Kipling's ideal longing to be a reality in which he says—

"But each for the joy of the working
And each in his separate star
Shall paint the thing as he sees it
For the God of the things as they are."

At the same time we all must admit in our own individual experience that the work which has actually been disposed of with least fatigue, was the work in which we were absolutely at peace—working for the "joy of the working."

It would seem, then, that ultimately, efficiency study will itself prove most efficient when the study of the inanimate job gives way to the study of the human mechanism and its ability to functionate in peace and contentment under a task best suited to the individual.

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**The Electrical Utilization Orders**

The effective work that is being done throughout the West in an effort to reduce accidents is highly commendable. In California this work has proved unusually effective due to the close co-operation that exists between the State Industrial Accident Commission, the employer and the workman.

One strong factor that is to be mentioned in any analysis as to why accident prevention has proved so effectual in California is to be found in the manner in which the commission goes about its task of drawing up rules and regulations. Before any important regulations are posted they are first gone over and aired thoroughly by deputations representing the employers and the workmen involved. When thus harmoniously launched upon a common task of bringing about a means for promoting the common good in the most effectual manner the victory is half won even though the actual written drawing up of rules were lacking.

The latest rules of interest to electrical men put forth by this commission have just appeared under the heading of California Electrical Utilization orders. In general these orders appear to receive the commendation of electrical men. Especially is this true for the order covering the grounding. At best orders of this nature are difficult to specify so as to prevent a misunderstanding. For this reason members of the electrical industry should proceed with great patience until sufficient reflection and tryout of these orders can be had to demonstrate just wherein the orders may be defective, if defective at all.

---

**Excellent Status of Electric Manufacturers**

The general financial status of the electrical industry has been at no time in its history in such remarkably sound condition as it is today. From the earnings of central station companies on up through contractor, dealer, jobber to manufacturer the report comes back that sane management and careful reckoning are putting all lines of the industry on such a firm standing that permanency in stability is bound to result.

That many of the electric manufacturers have ceased to take munition contracts, holding their reserve in trained men and equipment solely for the use of the nation in case of war emergency, is another gratifying incident of recent trend in events electrical.

Take for instance the February financial statement of a prominent electrical manufacturer. The statement shows an increase in surplus of about 7 per cent, bringing the total surplus to more than $850,000. The net earnings broke the record for February, a short month, being greater than in any February since the founding of the company twenty-eight years ago. It is further stated that the bookings continue good and this represents straight electrical business, as the company, after completing several highly profitable munition contracts, has returned to the exclusive manufacture of electrical equipment. However, it has been announced that the company stands ready to re-enter the munition business if called upon by the United States Government, as it has, in addition to the equipment, the trained men necessary for the work. The common stock of the company continues on a permanent 8 per cent per annum basis, with the preferred yielding 7 per cent.

Such reports as these are indeed gratifying and lead men of the industry to come to a fuller realization of what the industry means to the country at large in the event of war and to continued peace and prosperity as the years of national growths unfold.

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**Exaggeration vs. Modesty in Expression**

As someone has recently said "most of us are simple folk and we prefer to listen to language we can understand."

In no profession does such a statement apply with more force than in the electrical industry, where there are so many things that display inherently such wonders of truth that super-excellences of expression are uncalled for.

This state of affairs is not only to be observed in the oral expression of the engineer but indeed in every line of activity reached by the intricacies of his profession. The recent creation of the Wise power plant of the Pacific Gas & Electric Company ably illustrates this point. Upon entrance to this power plant the extreme simplicity of expression almost overcomes one when an endeavor is made to gather the fact in mind that herein is displayed before the vision the workings for the largest single discharge turbine unit thus far created in the art of engineering. When the switch was thrown to connect in the unit one would have been unadvised of this triumphant feat in engineering were he not a close observer of the operating movement at the switchboard.

Applying this same principle of design to expression in all phases of activity in the electrical industry —engineering, salesmanship, executive control— modesty and a firm respect for the precise truth are qualities that are certain to command respect—partly through their inherent charm and partly through the infrequency of their use. In a branch of the art such as the electrical industry precision of expression is of utmost importance.

# PERSONALS

**M. R. Buchanan** of Silver City, New Mexico, has recently been elected president of the New Mexico Electrical Association for 1917-18. Mr. Buchanan's rise in the electrical industry has been rapid. In 1910 he accepted the position of superintendent of the New Mexico Light, Heat & Power Company of Silver City, which was taken over in 1912 by the Silver City Power Company. At that time he was given the position of manager, and has continued to fill this position to the present time in a most efficient manner. The prospects for the New Mexico Electrical Association are exceedingly bright for the coming season and members throughout that state are already looking forward to the 1918 gathering.

**T. G. Whaling,** assistant general manager and sales manager of the Westinghouse Lamp Company, is a recent San Francisco visitor.

**C. G. A. Baker,** vice-president and secretary of the Baker-Joslyn Company of San Francisco, recently returned from a short trip to Los Angeles.

**B. J. Klein,** Pacific Coast manager of the Bristol company recently returned from an extended business trip throughout the Northwest.

**F. W. Milligan,** president and ceramic engineer for the General Porcelain Company, of Parkersburg, West Virginia, is visiting the Pacific Coast.

**F. H. Rieber,** chief engineer of the Rieber Laboratories, has returned to his home office in San Francisco after an extensive trip throughout the East.

**Romaine W. Myers,** an electricial and illuminating engineer of Oakland, has been retained as consulting electrical engineer for the Judson Iron Works.

**J. N. LeConte,** professor of engineering mechanics, is recovering from an operation of appendicitis undergone recently at the Alta Bates Hospital in Berkeley.

**Neil Hurley,** president of the Hurley Machine Company of Chicago, and his nephew, have spent several weeks in California and left San Francisco for Chicago, Wednesday, March 20.

**Henry F. Holland** has severed his connection as manager of the electric range department of the Great Western Power Company at San Francisco and will be at Los Angeles until further notice.

**Geo. A. Campbell,** manager Truckee River General Electric Company at Reno, Nevada, has been elected president of the Reno Commercial Club, whose one thousand members practically constitute a state organization.

**Willis M. Deming,** of Schenectady, N. Y., has resigned his position with the General Electric Company and will spend some time on the Pacific Coast in rest and recreation, for which he has long felt the need.

**Hal Lauritzen,** of the Pacific States Electric Company, recently returned from a business trip throughout the East where he visited the factories of the Ivanhoe Regent Glass Works of the General Electric Company.

**H. R. Noack,** of the Pacific States Electric Company of San Francisco, recently returned from an extended trip throughout the east, where he visited the factory and offices of the Hubbard Company and Pierce Specialties at Pittsburg, Pa.

**H. F Hartzel** of the San Francisco office of Baker-Joslyn Company, has recently been transferred to Los Angeles as the Los Angeles manager of that company.

**J. C. Martin,** of the engineering staff of the Pacific Light & Power Company at Portland, has been promoted to the position of chief engineer. **W. N. Voegtly** has been appointed purchasing agent of the company to succeed C. H. Still, resigned.

**T. E. Burger** has been transferred from the position of manager of the Western Electric Company, Los Angeles, to the position of assistant manager of the company at San Francisco, the Los Angeles position has been filled by transferring **D. J. Butts** from Salt Lake City.

**J. H. Montague,** representative of the Chance Manufacturing Company of Centralia, Mo., manufacturers of the "Never Creep" Anchors, is a recent visitor at San Francisco, making tests and demonstrations of his anchors before the Bell Telephone Company and others.

**F. O. Broili** has resigned as industrial power engineer of the Northwestern Electric Company of Portland, Oregon, to become president and engineer for the Nevada Machinery & Electrical Company at Reno, Nevada, and also to do some special engineering work for the State of Nevada.

**T. L. Stannard,** a consulting engineer of the Northwest, formerly engaged in constructing the second unit of the municipal plant in Seattle, has been appointed by the city council of Portland to investigate the proposed municipal light plant proposition now under consideration by that body.

**J. William Peterson,** vice-president and general manager of the Richardson-Phenix Company of Milwaukee, is an interested Pacific Coast visitor. During his sojourn in San Francisco, Mr. Peterson gave an address on 'Lubrication" which was listened to by an attentive audience at the Merchants' Exchange Building.

**F. G. Baum** has left for Lead, S. D., where he is installing a 4000 kw. hydroelectric plant for the Homestake Mining Company, the largest gold producer in the United States. **A. L. Wilcox,** who has been in Peru the past five years on the hydroelectric work for the Cerro de Pasco Mining Company, will have charge of the Homestake work and **A. M. Torpen** of **F. G. Baum's** office, has been placed in charge of the second hydroelectric plant in Peru.

**George H. Duffield,** after seven years of continuous service as secretary of the National Electrical Contractors' Association of the United States and business manager and editor of the association's official journal, The National Electrical Contractor, resigned February 1st to take effect April 1st Mr. Duffield has accepted a position with the McGraw-Hill Publishing Company, Inc., New York, as business manager of "Electrical Merchandising," and will also serve in an editorial capacity.

**J. G. Scrugham,** professor of mechanical engineering and dean of the engineering college at the University of Nevada since 1903, has been appointed State Engineer of Nevada. Mr. Scrugham carries to his new position a wealth of experience, having formerly been a consulting engineer for the Oregon Short Line, an assistant engineer for the Southern Pacific Company and consulting engineer and director for Elko-Lamoille Power Company at Elko, Nevada. He is first vice-president of the engineering division of the Associated Land Grant Colleges and served as chairman of the jury for mechanical awards at the Panama-Pacific International Exposition.

# MEETING NOTICES FOR ELECTRICAL MEN

*(The subject of war and its effect upon the life and activity of the engineer has largely engaged the attention of meetings of the electrical industry in the West during the past two-week period. Preparations for the Pacific Coast Convention of N. E. L. A. at Riverside, Cal., and of the Northwest Electric Light & Power Association convention at Spokane, Wash., have also been reflected in activities of the various electrical development gatherings throughout the West. In this issue the Journal presents its second "Builder of the West" in the personage of John A. Britton, the much beloved and respected vice-president and general manager of the Pacific Gas & Electric Company.—The Editor.)*

### San Francisco Section of A. I. E. E.

The San Francisco Section of A. I. E. E. met in regular monthly session at the Engineer's Club on Friday evening, March 23, 1917. J. A. Vandegrift of the National Lamp Works of the General Electric Company in Oakland, gave a paper on "Interesting Features in Connection with the Manufacture of Incandescent Lamps." The lecture was well illustrated with slides and the fifty men present enjoyed a profitable evening.

### The San Francisco Electrical Development and Jovian League

Robert Sibley, editor of the Journal of Electricity, addressed the meeting of the San Francisco Electrical Development & Jovian League at the Palace Hotel on March 14, 1917. The speaker described in an interesting and entertaining manner recent experiences and observations in a tour of the Orient. Especial effort was made by the speaker to pave the way for a detailed presentation of possible future commercial and engineering activity in the Orient, which is to be the subject of an address by Julean Arnold, American Commercial Attache to China, who is to address the meeting on April 4. Percy Pitts, of the Pacific Gas & Electric Company, acted as chairman of the day.

The officers for the coming term were elected as follows: President, R. M. Alvord; vice-president, R. F. Behan; and members of the executive committee, Percy Pitts and E. E. Brown.

Chas. H. Victor, manager of Yawman & Erbe Co., was speaker for the meeting of Wednesday, March 21. Mr. Victor, who was introduced by W. S. Coleman of the Pacific Gas & Electric Company, spoke entertainingly and helpfully on the subject of proper kind of recreation for salesmen.

### The Engineer's Club of San Francisco

The members of the San Francisco Engineer's Club listened to a most interesting lecture by John R. Brownell, superintendent of safety for the California Industrial Accident Commission on Thursday noon, March 15, at the club rooms in the Mechanics' Institute Building. The speaker described the work of the commission in promoting safety study and the prevention of accidents in California.

### Los Angeles Jovian Electric League

The American Red Cross was featured at the luncheon on Wednesday, March 21st, and the earnest and faithful workers of the Los Angeles Chapter took the league by storm and succeeded in enrolling not only every member but the league itself as a member of the Red Cross. R. H. Ballard, secretary and assistant general manager of the Southern California Edison Company, was chairman of the day, and made a few interesting introductory remarks in keeping with the spirit of the occasion, after which he introduced the speaker of the day, Mrs. Martha Nelson McCan, whose topic was "The Purpose of the American Red Cross." Making the startling statement that the United States has the smallest Red Cross membership of any of the larger nations, she appealed to the sympathy, patriotism and Americanism of her hearers, urging their support and assistance. Miss Gladis Cosgrove, instructor with the first aid classes now being established throughout the city, also spoke, explaining this phase of the work.

## BUILDERS OF THE WEST—II

JOHN A BRITTON

**That a man should prove, under fire, to have unusual executive ability in building the world's greatest hydroelectric distribution system—a system now heralded far and wide for its triumph in physical attainment and unrivalled esprit de corps in organization of its personnel—is indeed a distinction few live to attain. But, when through it all is manifested a kindly, buoyant desire to help one's fellow man, then indeed shows forth the spirit to be observed in those who should be classed among the true builders of the West. To John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, this issue of the Journal is affectionately dedicated.**

### By-Weekly Luncheon of Portland Sections of N. E. L. A. and A. I. E. E. with the Oregon Society of Engineers

The bi-weekly luncheon of Joint Sections of the A. I. E. E. and N. E. L. A. with the Oregon Society of Engineers was held under the auspices of the Oregon Society of Engineers. J. P. Newell, vice-president, was chairman.

The speaker of the day was E. H. Beals, district forecaster, U. S. Weather Bureau, Portland, Ore. His subject was "Weather Forecasting."

### Portland Sections of A. I. E. E. and N. E. L. A.

A joint meeting of the local sections of the American Institute Electrical Engineers and National Electric Light Association was held in one of the assembly halls of the Multnomah Hotel Tuesday evening, March 6. L. T. Merwin of the Northwestern Electric Company, was chairman and the speaker of the evening was W. J. Davis, Jr., of the General Electric Company. The subject of the paper was "Electric Drive for Battleships and Gear Reduction." The application of the principal of the reduction of gears to cargo ships received special attention from the speaker. The use of the electric drive for battleships and cruisers also was considered. The effect of the electromagnetic clutch in the world of engineering was described. The lecture was illustrated with lantern slides and sketches. About 300 engineers attended.

### Oregon Society of Engineers

The regular monthly meeting of the Oregon Society of Engineers was held at the power plant of the Northwest Electric Company's plant in the Pittock Block, Portland, Oregon, Friday, March 16, 1917, at 8 p. m.

L. P. Merwin and his assistants, showed about 60 members of the Society through the steam electric and steam heating plant of the Company.

### The Pacific Coast Gas Association Convention

The Pacific Coast Gas Association will hold its 25th annual convention at Santa Cruz, California, September 18 to 21, 1917.

The first exhibition of gas appliances held in connection with the convention at Long Beach, California, in 1914, was so successful, and the appliance section of the association has become each year more important, so that a committee of appliance men was appointed by the association to arrange for an exhibit of gas appliances during the convention week at Santa Cruz. The committee having this in charge consists of the following members: B. S. Pedersen, (chairman), George M. Clark & Company; H. W. Jackson, James Graham Manufacturing Company; R. L. Cardiff, Coast Counties Gas & Electric Company; L. C. Braun, Eclipse Stove Company; R. J. Thompson, Welsbach Company; Paul E. Haugh, Trenkamp Stove & Manufacturing Company; T. Leary, H. Mueller Manufacturing Company.

The committee has made arrangements for the holding of an exhibit of gas appliances at Santa Cruz, which it is expected will be better and more comprehensive than any heretofore had on the Pacific Coast. The ground floor of the "Casino" will be available for the holding of this exhibition, giving ample room in one of the finest exhibition halls in the West with all the facilities for exhibiting goods that can possibly be had.

### A. I. E. E. Nominations

At the meeting of the board of directors of the American Institute of Electrical Engineers held in Chicago on March 9, the report of the commttee of tellers in its canvass of the nominaitnon ballots for candidates for the institute offices falling vacant July 31, 1917 was presented. As required by the constitution of the Institute, the board then selected by ballot its list of "Directors' Nominees," with the following result:

For President: E. W. Rice, Jr., Schenectady, N. Y.

For Vice-Presidents: Frederick Bedell, Ithaca, N. Y.; John H. Finney, Washington, D. C.; A. S. McAllister, New York

For Managers: Walter A. Hall, West Lynn, Mass.; E. H. Martindale, Cleveland, Ohio; Wm. A. Del Mar, New York; Wilfred Sykes, Pittsburgh, Pa.

For Treasurer: George A. Hamilton, Elizabeth, N. J.

### An Electrical Council of the Board of Fire Underwriters

An electrical council of the underwriters' laboratories has recently been established by the board of directors which will deal with standards and reports on electrical materials and devices for light, heat and power, superseding in this department the fire council to which such standards and reports have formerly been addressed.

### Standing of the Electric Baseball Clubs

| | Won | Lost | Pct. |
|---|---|---|---|
| General | 2 | 0 | 1000 |
| Ermsco | 1 | 1 | 500 |
| Western | 1 | 1 | 500 |
| States | 0 | 2 | 000 |

The Electric Baseball League began the season's play on Saturday, March 10th, when the Pacific States Electric Company "champs" of last year, was handed a 13 to 8 defeat by the ERMSCO team. The game was a "slug fest" from start to finish, both teams finding the opposing pitchers easy.

Mr. Samuel H. Taylor, president of the Electric Railway & Mfrs. Supply Company, opened the season by pitching the first ball. He throws from the port side, and from his delivery one would believe that Mr. Taylor is a big league pitcher. It is such an unusual occurrence for a "league opener" to reach the plate that we take special pains to mention the fact that Mr. Taylor not only reached the plate—but—he actually reached the catcher. After performing this great feat—he walked from the box and the game was in progress.

O'Connell started in the box for the "States" while Finley "tossed 'em" for Railway. It was cold and windy, consequently a bad day for pitchers.

The ERMSCO nine batted first, and by the time the third out had been registered, three runs had crossed the plate. The "States" came back in their half with two, but when the Railway scored three more in the second and one each in the fourth and fifth it looked like an easy ERMSCO victory, with the score 8 to 2. But, in the fifth the States found Finley for 1 run. Two doubles, scored another in the sixth. They added three more in the seventh. With nobody out, Rylander replaced Finley the next three batters being strike-out victims.

ERMSCO went to bat in the eighth leading 8 to 7, but this lead didn't satisfy them, so they chased four more runs across the plate. One more in the ninth made the total count thirteen. The best the "STATES" could do was to gather one more in the eighth, making their total eight.

And so the battle royal has continued with the result to date as set forth in the above tabulated statement.

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## BOOK REVIEWS

**Telephone Apparatus. By George D. Shepardson;** size 6 in. by 9 in.; 337 pp.; 114 illustrations; cloth binding. Published by D. Appleton & Company of New York and London, and for sale at the Technical Book Shop. Price $2.00.

The author of this work is professor of electrical engineering at the University of Minnesota. The treatment of the text is made under four main headings—speech sounds, receivers, transmitters; signaling equipment; sources of electromotive force and protection; and appendices.

This volume deals principally with apparatus, giving only minor attention to circuits. The book presumes that the reader has a working knowleige of algebra, trigonometry, calculus, and physics, including the laws govering direct and alternating currents. Appendices are given in the back of the volume for such readers who may be out of practice with the more extended mathematical developments of the text. The book is replete with references which should prove valuable for further research and study on the subject. The work should prove especially valuable for advanced students in telephony.

**Electric Central Station Distribution Systems.** By Harry B. Gear, A. B., M. E. and Paul F. Williams, E. E. Second edition, thoroughly revised and enlarged. Size 6 in. by 9 in.; 456 pp.; 187 illustrations; cloth binding. Published by D. Van Nostrand Company and for sale at the Technical Book Shop, San Francisco. Price $3.50.

The rapid changes in the conditions under which electricity is distributed and the progress made since the first appearance of this treatise have necessitated numerous changes and additions of considerable new matter. The subject of urban transmission and high-tension distribution has been made the subject of a separate chapter. The discussion of overhead and underground construction has been made to include recent progress. The diversity factor has been broadened and supplemented in discussion. Other chapters are devoted to separate considerations of substations, voltage regulation, line transformers, secondary distribution, protective apparatus, cable work and distribution economics.

The mechanical features of the text and illustrations are clear and well executed. The matter as treated is of high order and should engage the attention of all interested in the subject under consideration.

## COMMISSION NOTES

### Notes of Utilities Commission of Idaho

In the matter of the application of the Washington Water Power Company, a corporation, for relief from certain requirements of General Order No. 10, the petition is granted.

In the matter of the application of W. W. Roberts and C. T. Inskip, partners, doing business under the firm name and style of Roberts-Inskip Plumbing & Heating Company, for a certificate of public convenience and necessity, the commission denied the request.

### Notes of Utah Utility Commission

The Utah legislature has enacted a public utilities law and it has been approved by Governor Bamberger. A public utilities commission is created and they have been given jurisdiction over the steam and electric railways, all common carriers, express companies, lighting, power and gas companies, heating companies, telephone and telegraph companies, water corporations including irrigation companies, and warehousemen. A salary of $4000 is provided for each of the three commissioners. A strong attempt was made by some of the members of the legislature to have included within the jurisdiction of the commission coal companies, sugar companies, lumber companies and other lines of trade which may be found by the commission to have a virtual monopoly of the business in the state but this provision was finally defeated.

### Notes of California Water Commission

George H. Ayers of Fort Bidwell has applied to the State Water Commission for permission to appropriate 575 cubic feet per second of the waters of Cowhead Lake and 125 cubic feet per second of the waters of Twelve Mile Creek, both tributary to Twenty Mile Creek in Oregon, the diversion being in Modoc County. The proposed diversion and storage dam dimensions are given as follows: Height of dam, 45 ft.; width at top 650 ft.; width at bottom, 135 ft. The type of construction is given as rock fill. A main canal 44 miles long is part of the proposed works. The reservoir created by the proposed dam is intended to hold 115,000 acre feet of water. The estimated cost is given as $450,000 and the acreage to be watered as 40,000.

Benj. J. Bennett of Salt Lake City has applied to the State Water Commission for permission to appropriate 20,000 acre feet per annum of the waters of Baxter Creek in Lassen County for irrigation. The proposed works consist of a dam 65 ft. high, 1560 ft. at top and 590 at bottom of steel piling cut off, earth fill and rip rap face. The estimated cost of the project is given as $300,000 and the area to be watered as 10,000 acres.

W. P. Boone of Berkeley has applied to the State Water Commission for permission to appropriate 20,000 cubic feet per second of the waters of Kings River in Fresno County for the purpose of irrigating lands in Fresno, Tulare and Kings counties. It is proposed to organize a district to be known as the Kings River Conservation District. The application specifies a dam 300 to 315 ft. high, 1200 ft. long on the top and 215 ft. long at bottom of concrete construction, forming a reservoir with a storage capacity of 600,000 acre feet. The project proposes the irrigation of 1,200,000 acres and the estimated cost is given as $9,000,000.

Ed. Fletcher of San Diego has applied for twenty cubic feet per second of the waters of Santa Maria Creek, tributary to Santa Ysabel River for irrigation purposes. The diversion dam, which is also to be the reservoir dam, is as proposed, 60 ft. high, 600 ft. on top and 50 ft. on bottom of arched type with overflow over concrete face of dam. The proposed storage is 8000 acre feet. The works contemplate a pipe line and canal nine miles long. The estimated cost is given at $200,000 and the acreage to be irrigated as 1320.

The East Side Land & Water Company of Los Angeles, has applied for permission to appropriate 500 cubic feet from Cowhead or Pelican Lake and 125 cubic feet from 12-Mile Creek in Modoc County for irrigation purposes. The name of the proposed works is the Surprise Valley ditch. A main canal from the creek is to be, as proposed, three miles long and a canal from the lake to be 41 miles in length. The diversion dam on 12-Mile Creek is given in the application as 60 ft. long on top and 40 ft. on bottom, rock-filled and timber cribs. The diversion at the lake is also the storage dam. The construction is rock fill with inner core with back slope of rip-rap and front slope earth fill with rip-rap front face, to be perfected by a 10 ft. toe-wall of rubble masonry, a spillway of 30 ft. width on each side of dam. The proposed structure is to be 43 ft. high, 350 ft. long on top and 132 ft. on bottom, front face 3 to 1 slope and back face 1½ to 1 slope. The estimated cost is given as $800,000 and the number of acres to be irrigated as 25,185.

Frank K. Mott of Oakland has applied for 100,000 acre feet per annum of the waters of Ash Creek, tributary to Pit River in Modoc County, the works to be known as the Round Valley reservoir. There is a proposed storage dam 100 ft. high, 1000 ft. long on top, and 200 ft. on the bottom and 20 ft. wide on top with a height over water when full of 20 ft. The construction is of earth fill type with concrete cut-off wall.

W. B. Baker of Los Angeles and F. H. Merrill of South Pasadena have filed three applications with the commission for permission to appropriate water from several different sources for use in the Coachella Valley, in the vicinity of Indio, Coachella, Mecca and Thermal. The first application proposes to appropriate waters from Whitewater River, Mission Creek, Dry Morongo Creek, and Big and Little Morongo Creek, in San Bernardino and Riverside counties, and carry them into Morongo Valley. By means of dams erected across the various drainages and openings of Morongo Valley it is proposed to impound and store the said waters involving a watershed of about 170 square miles. The application states that storage is afforded for 240,000 acre feet of water. The second application asks permission to appropriate all the unappropriated waters of Pipes Creek and Antelope Creek in San Bernardino County and divert same into Morongo Valley and store same, involving a watershed of 28 square miles. The third application seeks permission to appropriate the waters of streams and creeks flowing into Baldwin's Lake and the waters of the Lake itself, and the unappropriated waters of Arrastre Creek, diverting the waters of Arrastre Creek into the lake also and there impounding them, involving a watershed of 54 square miles. These waters are then to be carried into Morongo Valley and stored with the others, the whole to be finally conducted to the lands proposed to be irrigated in the Coachella Valley. Permission is also asked for the waters of Snow Creek in Riverside County, it being the plan to pick them up in a flume that carries the other waters to the valley. The commission has allowed applicants further time in which to submit maps and other data.

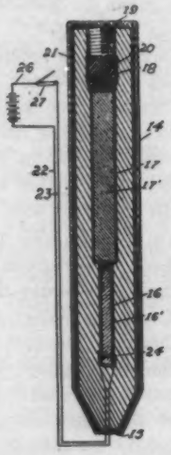
The City of Los Angeles has applied for 200 cubic feet per second of the waters of the South Fork of the Kern River in Tulare County for the purpose of generating electricity and power for that city. There is proposed a diversion dam 20 ft. high, 150 ft. long on top and 40 ft. on bottom of timber crib with metal gates in concrete settings. A conduit and pipe line five and one-half miles long will conduct the water to the power house, where under a 1500 foot head it is proposed to develop 18,000 theoretical horsepower. The cost of the project is given as a million and a half dollars and the application sets forth that it is one of the units of the plant to be assembled by the city of Los Angeles, which will comprise several others in Inyo and Mono counties.

# WHAT WESTERN INVENTORS ARE DOING

*(The effect of war shows its imprint in patents of the last two week period in the invention of devices calculated to destroy submarines. The impetus in mining, too, is reflected in the invention of an electric-blasting-cap protector. The electric circuit controller, insulator, electric oven and a new electrode for the generation of pure oxygen also come in for their share of attention, as noted in the following briefs of recent patents issued at Washington.—The Editor.)*

1,218,504. **Electric-Blasting-Cap Protector.** Ford Alexander, Taft, Cal.

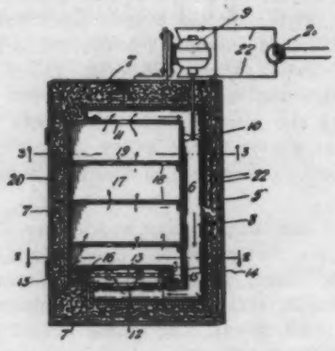
A detonating cap comprising a cylindrical body member of fragile material and having a pointed end, the member having a relatively small initial explosive chamber and a rela-



tively large explosive chamber connected therewith, the walls of the chambers being coated with a water-proof layer, a screw plug closing the large chamber, a water-proof layer inclosing the body member, a water-proof wrapping incasing the member, a second water-proof layer in the exterior of the wrapping, and electrically operated means for exploding the charge in the small chamber.

1,218,341. **Electric Oven.** Clarence Truitt, Pomona, Cal.

The combination with an electrically heated oven, of an air duct disposed between the walls thereof, and substantially surrounded by a non-heat conductor, the duct being contin-



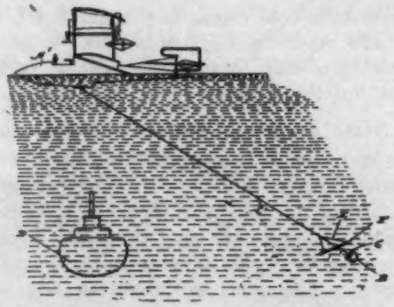
uous and communicating with the upper and lower portions of the oven, a heating elements disposed over an opening of the duct to retard the circulation and means to produce a cyclic change of air or other medium within the oven, through said duct, and force the air into contact with the element to reheat the air.

1,218,584. **Electrode for Generating Pure Oxygen.** John F. Sanders, Roseburg, Ore., assignor to Oliver P. Coshow, Roseburg, Ore.

A compound electrode consisting of a hydrogen absorbing substance and a catalyst adapted to render said electrode capable of giving up its hydrogen contained in solution.

1,218,586. **Destruction of Submarines.** Joseph A. Steinmetz, Philadelphia, Pa.

An apparatus comprising the combination with a flying boat of a bomb suspended at some distance below the boat by a suitable cable, and a forwardly and downwardly inclined



open tube connected with the bomb and arranged to be pressed downward by the action of the water when it is drawn rapidly through the water.

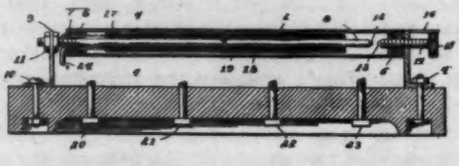
1,218,480. **Insulator.** John Sayer, Flagstaff, Arizona.

An insulator, a hollow metallic core extending throughout the length of the insulator, arms projecting outwardly from

the core and embedded in the body portion of the insulator, and a conductor extending through the core.

1,217,982. **Electric-Circuit Controller.** Will C. Neahr, Denver, Colo., assignor to The Protective Signal Manufacturing Company, Denver, Colo., a corporation of Delaware.

An apparatus of the character set forth, the combination



with a tubular member, of a rod member mounted longitudinally therein, coacting contact elements located in one end of the tubular member, one being carried by the rod, an electric heating coil mounted on the rod, and a sleeve of insulating material surrounding the rod and coil within the tubular members.

# LATEST IN EVERYTHING ELECTRICAL

*(The very latest in everything electrical for the past two-week interval is the unique and comprehensive telephone exhibit presented by the Pacific Telephone & Telegraph Company to the University of California Extension Bureau. A United States Supreme Court decision affecting power companies traversing national forests is also a happening of this period of immense importance to hydroelectric men generally. Apparatus of new features are also briefly described in the following pages, which should prove of timely interest to the engineer.—The Editor.)*

## A UNIQUE AND INSTRUCTIVE TELEPHONE EXHIBIT

BY C. H. JUDSON

The Pacific Telephone & Telegraph Company has donated to the Bureau of Visual Instruction of the University Extension Division, University of California, two rather remarkable exhibits. The exhibits are sent by the Bureau to the intermediate and high schools in the State of California in turn for the purpose of supplementing lectures and text books. One of the exhibits consists of a case with a glass front in which, mounted upon a velvet covered backboard, are the parts of the talking set, i.e., the transmitter and the receiver. The other exhibit, shown in the illustration, called the operating exhibit, consists of a central office switchboard section containing two line circuits and one cord circuit, together with coin collectingequipment. From the switchboard run subscriber lines to two telephone sets all contained in the case. Each of the subscriber stations is provided with a coin box and the usual protector equipment. One of the coin boxes is of the prepayment type, the other being the non-refunding box. In the telephone sets, the front boards are removed and glass plates substituted so that the operation of the interior mechanism is plainly visible. The coin boxes are similarly provided with glass fronts, and the course of the coins through the boxes may be traced. A case containing a battery of dry cells accompanies the exhibit which is thus rendered fully operative, and a connection from one telephone set to the other may be set up in the regulation manner. There is no glass front to this case so that the apparatus is entirely accessible for the purpose of demonstration.

A Forceful Educational Exhibit

The cases are provided with stout trunks for transporting. Tablets explaining the exhibits are attached to the cases, the text being printed on an enameled plate. The operating section has, attached to the left side, a hinged leaf upon which is mounted a photograph of a section of a standard central office switchboard. Circulars containing the descriptive matter are also supplied.

The exhibits are the product of much thought and painstaking effort on the part of the engineers of the Telephone Company who were given the task of preparing them.

The Bureau of Visual Instruction is doing a remarkable work in the schools of the State. It has already in use a very large number of exhibits illustrating the manufacturing industries of the country. In these the processes of manufacture are illustrated by photographs and samples of the products from the raw materials to the finished articles are shown. In the schools, the students are instructed to study the exhibits and to write the stories which they get from them. In addition to the drill in composition, the pupils gain a knowledge of the important industries which is of incalculable benefit and which in the great majority of cases has heretofore been inaccessible to them.

The Telephone Company's exhibits were shown at the Rotary Club and at a luncheon of the Home Industry League prior to being put on the school circuit. They have been on exhibition at the Lick School, Wilmerding School, Lux School, Polytechnic High School and Cogswell School in San Fran- Polytechnic High School and Cogswell School, Oakland. They will be at the Oakland High School, Oakland, from April 9 to April 23.

## A FAR REACHING COURT DECISION

Regulations of the Agriculture and Interior Departments' conservation policy and decrees requiring the Utah power companies to remove their property from the public lands unless they procure Federal permits were sustained recently by a decision of the United States Supreme Court.

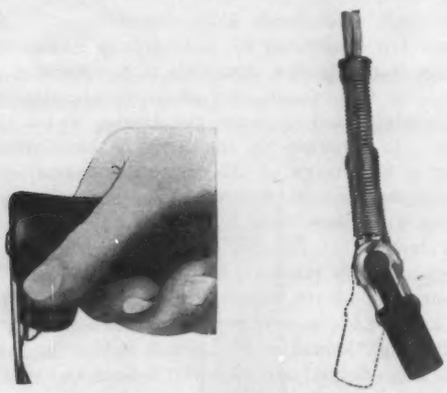
The court maintained the power of Congress to regulate all public lands and denied that its authority was limited to lands actually used for Federal purposes. All government regulations were not specifically upheld, but the court refused to disturb any of them. It also held the government to be entitled to reasonable compensation from the Utah power concerns for use of lands occupied.

Far-reaching questions affecting electric power development in Utah, Colorado, Idaho, Nebraska, Nevada, California, and other "public land" states, and incidentally presenting some of the most fundamental questions of states rights to come before the Supreme Court in many years, were involved in the government's suit to force the Utah Power & Light Company and the Beaver River Power Company from public lands in the Wasatch and Fillmore Forest Reservations in Utah.

Judgments directing both companies to remove their plants from the forest reserves, but refusing an accounting to the government, were entered on March 4, 1915, by the Utah Federal Court.

## A NEW DEVICE TO PREVENT CORD BREAKAGE FOR ELECTRIC IRONS

Cord Breakage in electric irons has been a source of much worry to consumers, dealers, and manufacturers, and has really come to be considered as almost an incurable malady. Numerous remedies have been prescribed, tried, found ineffective, but as usual perseverance has triumphed. Word comes from the Development Department of the Hotpoint Electric Heating Company at Ontario, California, of a hinged cord protector switch plug which eliminates cord



New Preventatives for Electric Iron Cord Breakage

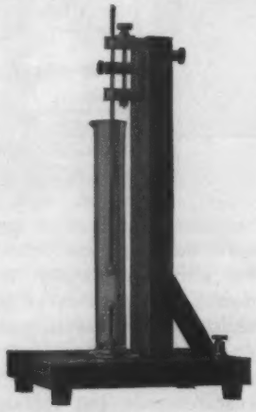
breakage and the many other ills to which previous style plugs were heir.

Our correspondent advises the general construction of the plug and path of the cord as it leads into the plug to be as follows:

"The cord first passes through a smooth composition bushing at upper end of a spiral spring which prevents chafing at that point. It continues through the double spiral spring, the ends of which are securely fastened to the slide hinge joint at upper part of metal plug cap. The spiral spring supports the cord and prevents sharp bendings or kinks (most common near the plug) in the cord. The hinge joint still further relieves the cord and by adding flexibility, spring will not interfere with arms of operator. The composition plug bar forms an anchor for the cord, which is wrapped around it in a way to relieve all possible strain from the copper conductor and where it is fastened to the binding screws. The increased length of cord necessitated by the loop around the plug bar prevents heat reaching point at which actual bending occurs which further adds to life of conductor."

## NEW OIL TESTING CUP

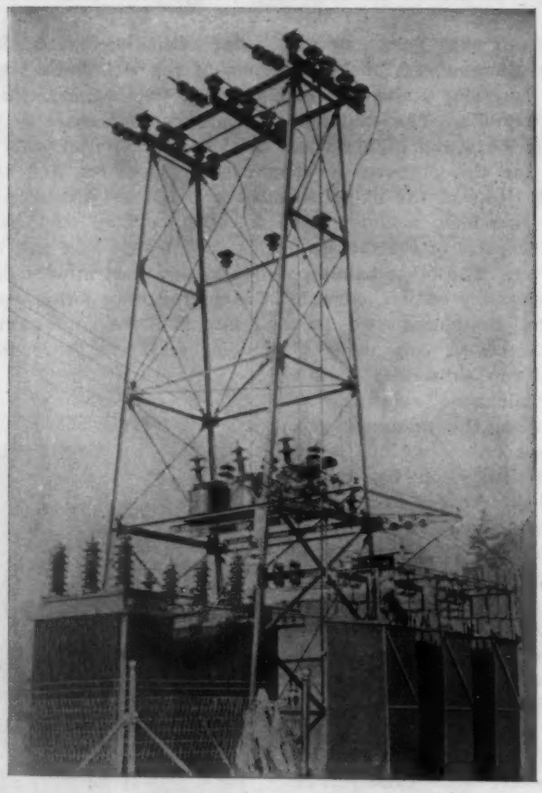
The oil testing cup shown, which consists of a graduated glass cylinder containing two testing terminals, each a brass sphere ½ inch in diameter, has been placed on the market by the Westinghouse Electric & Manufacturing Company of East Pittsburg, Pa., for convenience in making dielectric tests of insulating oil. The upper sphere is adjustable in its distance from the lower one by means of a micrometer screw with a milled thread.



New Oil Testing Cup

## OUTDOOR SWITCH-HOUSES

The problem of properly housing and protecting switching equipments is one of considerable importance in installations which supply electrical power to small towns, manufacturing plants, mines, etc., where the load is not large enough to warrant the expense of a substation with indoor apparatus. For outdoor distributing substations of this character, portable switch-houses such as are shown in the accompanying illustrations, have been found to give such satisfactory service that the tendency is toward an increase in their application as well as in their size and capacity.



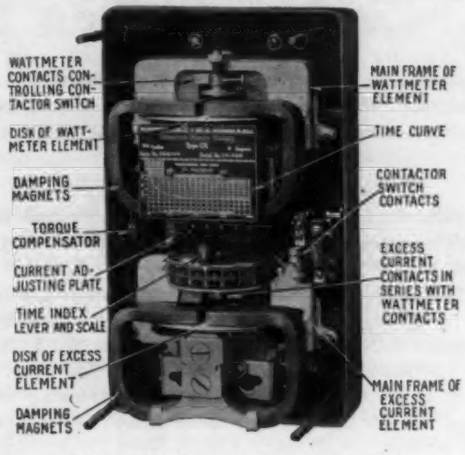
A Typical Outdoor Switch-house

## EXHIBITS OF CLASS "D" MEMBERS IN CONNECTION WITH THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION MILLION DOLLAR PIER, ATLANTIC CITY, NEW JERSEY

The exhibition committee have issued their circular covering the exhibits to be held in connection with the convention of the National Electric Light Association on Million Dollar Pier, Atlantic City during the week of May 28th. The floor plan shows the location of exhibits, meeting rooms, registration bureau, committees and sections with all other details, including the exhibit of the Lamp Committee, lighting appliance section and electric vehicle section, also full details and cost of space. The exhibit committee announce that they have secured almost double the space used in former years, and are pleased to advise that they have been able to reduce the cost of space by less than half any previous exhibit.

## THE INDUCTION RELAY

The first induction type of relay was placed on the market in 1902 by the Westinghouse Electric & Manufacturing Company. The induction principle of the operation was the same as had been used with great success in the company's alternating current integrating wattmeters (now watthour meters) for several years prior to this time. Even in its early design, this relay was superior in accuracy, reliability, and


WATTMETER CONTACTS CONTROLLING CONTACTOR SWITCH
DISK OF WATTMETER ELEMENT
DAMPING MAGNETS
TORQUE COMPENSATOR
CURRENT ADJUSTING PLATE
TIME INDEX LEVER AND SCALE
DISK OF EXCESS CURRENT ELEMENT
DAMPING MAGNETS
MAIN FRAME OF WATTMETER ELEMENT
TIME CURVE
CONTACTOR SWITCH CONTACTS
EXCESS CURRENT CONTACTS IN SERIES WITH WATTMETER CONTACTS
MAIN FRAME OF EXCESS CURRENT ELEMENT

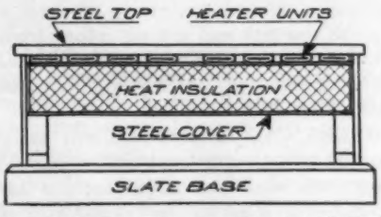
Detailed View of Induction Relay

sensitivity, to relays operating on other principles. One form was enclosed in a round case, while the other was of open construction designed for mounting on a panel board. The torque compensator was first placed on the market in 1913 by the same company, as a separate device to be used in connection with the induction relay.

Since its introduction, the development of the induction type of relay has advanced continuously. It has had various forms and has finally culminated in two types of relays, the torque compensator being included self-contained, as a part of the relay.

## THE USE OF INDUSTRIAL ELECTRIC HEATERS

In the Bureau of Engraving and Printing, Washington, D. C., 600 C-H rectangular industrial stoves are in use for the heating of engraved plates from which bank notes are printed.




Heater Unit for Warming Engraved Plates

In the accompanying illustration some of these units (made by The Cutler-Hammer Manufacturing Company of Milwaukee) can be seen. These stoves are spring mounted in a cradle so that there is a pressure upward against the under side of the plate.

## A NEW CORD CONNECTOR

The extensive use of the three-wire line, introduced by Harvey Hubbel, Inc., of Bridgeport, Conn., about three years ago, has made necessary the addition of a durable 10 ampere cord connector which could be used in linking up permanently installed wall or flush receptacles with portable machines, appliances and laboratory apparatus wired for three-wire work. The composition cap of this connector is interchangeable with all of the three-wire attachment plug bases, wall receptacles and flush receptacles listed by the company.

## NEW BULLETINS

The Underwriters Laboratories, Chicago, are now issuing a pamphlet entitled "Electrical Data," giving typical causes and losses from fires of electrical origin. Copies may be had upon application.

The Sprague Electric Works of the General Electric Company has recently issued bulletin 41514, descriptive of single-phase motors of varying speed type, also an interesting pamphlet on electric fans has just made its appearance to the trade.

The publicity department of H. M. Byllesby & Company, has just completed some very useful and attractive booklets for distribution to consumers. These books are designed to place in the hands of the customer, the general information referring to his service, and contain considerable educational matter concerning meters, basis of rates, definition of gas and electrical terms, etc.

"Westinghouse Electric Fans" is the title of Catalogue 8-A just issued by the Westinghouse Electric & Manufacturing Company. A series of leaflets on the electric range, controllers for steel mill and crane service has also made its appearance to the trade. "Manager Wise buys Westinghouse Small Motors" and "Westinghouse Railway Accessories" are also recent booklets by this company covering matter suggested in the title.

## TRADE NOTES

The Garland-Affolter Engineering Company of San Francisco, dealers in Moloney transformers, Howell polyphase motors, Peerless single-phase motors, electrical controlling apparatus, high tension substation and pole line equipment has opened branch offices in the San Fernando Building, Los Angeles.

Wilbur J. Watson, William R. Davis and Harlan Miller, a group of engineers heretofore united for the purpose of designing a San Francisco-Oakland bridge, have made announcement of their organization as the Watson-Davis-Miller Company, for the purpose of conducting a general consulting, designing and inspecting engineering business with offices in Cleveland, O., Albany, N. Y., and San Francisco, California.

F. S. Viele, president of the Arizona Power Co., reports that the company has entered into a contract with the Consolidated Smelting Company for a three-year term with a minimum of 1000 h.p. It is expected that actually from 1200 to 1400 h.p. will be used. This is about double the amount used at present. The Arizona Power Company has also closed a contract with the Gadsden Company and has made new contracts with the Jerome Victor Extension and the Verde Combination. Work is going forward rapidly on the new Arizona steam generating plant.

A third hydroelectric unit has been purchased to be installed at the White River plant near Seattle, Wash. The turbine will be 23,000 h.p. capacity under 440 ft. net head and 360 r.p.m. The generator will have a rating of 20,000 k.v.a. Owing to the eminently satisfactory performance of the present two units which have been in service continuously for over five years, the contract has been awarded the hydraulic department of the Allis-Chalmers Manufacturing Company, including all accessories, such as governor, relief valve, and butterfly valve. The electrical equipment will again be furnished by the General Electric Company.

# NEW ELECTRICAL DEVELOPMENTS

*(The most significant new electrical development of the two-week period comes from Portland where it develops that the municipal electrical enterprise previously thought possible at a low cost of service is now said to be underestimated by such a considerable figure as to make its passage by the people at an election in June a case of considerable doubt. Other notations of happenings throughout the West are appended.—The Editor.)*

## FINANCIAL

SAN FRANCISCO, CAL.—The Northern California Power Company, consolidated, for 1916 shows an increase in net income over the previous year of $56,304, or 13.2 per cent. Net after interest was $128,738, a gain of $66,280 for the year. President W. F. Detert, in his report to stockholders, says interest paid during 1916 was $9075 less than the amount paid in 1915, and the amount of interest charged to capital on account of construction work in progress during the year, so that the amount of interest properly chargeable to the year's operations was $9976 less than for the preceding year. An inspection of the report shows that there has been a growth in all departments of the company's business—approximately 9.1 per cent in electric, 13.6 in gas and 2.1 in water revenues.

SAN FRANCISCO, CAL.—The Mt. Whitney Power & Electric Company has reported to Blyth, Wittier & Company earnings for the calendar year of 1916 as follows:

| | |
|---|---|
| Gross revenue | $782,207.40 |
| Operating expenses, maintenance and taxes | 331,847.57 |
| Uncollectable accounts | 8,986.94 |
| Net revenue | 441,372.89 |
| Bond interest | 199,573.96 |
| Balance | 241,798.93 |

It is most interesting to note the effect upon this company's business of the reduction in its rates which was made by the Railroad Commission early in 1916, at a hearing held at the company's request. Revenues in each department have registered healthy increases, due to new business which has been taken on by reason of the lower rates.

SAN FRANCISCO, CAL.—Coast Counties Gas & Electric Company closed the calendar year 1916 with gross earnings of $363,979, net operating income of $167,740, and a cash surplus after all expenses, charges and depreciation allowances of $67,519. This surplus compares with $59,201 earned in 1915, and the other items of the account show a corresponding improvement. The income statement for the year and the balance sheet, as of December 31, 1916, follow. Income account for 1916:

| | |
|---|---|
| Gross earnings | $363,979.66 |
| Operating expenses, inc. taxes | 196,239.27 |
| Net operating income | 167,740.39 |
| Bond and debenture interest | 76,536.96 |
| Other interest | 2,522.20 |
| Amortization of debt, discount and expense | 1,162.08 |
| Depreciation | 20,000.00 |
| Surplus | 67,519.15 |

The Coast Counties Gas & Electric reports earnings for the two months ended February 29, 1916, as follows:

Gross earnings: 1917, $57,122.13; 1916, $53,560.28, increase, $3561.85; expenses, maintenance, taxes, 1917, $29,067.19; 1916, $28,295.66; increase, $771.53; net income, 1917, $28,054.94; 1916, $25,264.62, increase, $2,790.32; bond interest, 1917, $11,055.50; 1919, $11,370.53; decrease, $315.03; other interest, 1917, $1898.81; 1916, $2111.32; decrease, $212.51; balance, 1917, $15,100.63; 1916, $11,782.77; increase, $3317.86.

## INCORPORATIONS.

SACRAMENTO, CAL.—Articles of incorporation of the Red Rock Irrigation Company of Red Rock, Lassen County, with a capital of $20,000, were filed this week in the office of the Secretary of State. The object of the company is to supply water to residents of the district for both irrigation and domestic purposes. The capital stock is divided into 20,000 shares of the par value of $1 each. The directors and incorporators are: August Anderson, of Westwood and Ira C. Anderson of Red Rock, both of whom have subscribed five shares.

## ILLUMINATION

COLUSA, CAL.—The board of supervisors has ordered the Northern California Power Company to install street lights on certain streets of the Williams lighting district.

PORTLAND, ORE.—The interstate bridge commission has awarded the contract for lighting the interstate bridge and its approaches to Nelson & Brown, contractors, for $4289.33.

LOS ANGELES, CAL.—The city council has ordered the installation of necessary appliances and furnishing of electric current for the lighting of Beacon street, between Fourth and Sixth streets.

LOS ANGELES, CAL.—An order has been made by the board of supervisors authorizing repairs and replacement of equipment in Bonita Meadows lighting district through the county mechanical department.

CLOVIS, N. M.—This city is seeking a loan to increase the capacity of its municipal light and water plant. A sum of $20,000, which is the least amount with which the enlargements can be made, must be obtained.

ATWATER, CAL.—An election will be held April 12 to equip and maintain a system of street lighting on public highways and to provide for the formation and operation of highway lighting districts in incorporated towns and villages.

FRESNO, CAL.—The board of supervisors has awarded the contract for establishing a lighting district at Caruthers to the San Joaquin Light & Power Corporation. The lighting system will consist of eight lights and the cost will be $1.85 per light per month. The contract is drawn for five years.

SALINAS, CAL.—The Coast Valleys Gas & Electric Company offers to lay a lighting system to the base of the poles without charge to the city and get its return from the lights. Expert Phillips recommends that the city own its own light system and small substation, which can be obtained at a total cost of $12,868.

LOS ANGELES, CAL.—Sealed bids will be received by the department of public service for 2000 suspension insulator units, each complete with malleable iron pin and cap, suitable for use seven in a series on 110,000 volt transmission lines, to be of best quality of brown glazed porcelain and approximately 10 in. in diameter.

FALLBROOK, CAL.—It has been voted to form the Fallbrook lighting district. Street lights will be installed by the San Diego Consolidated Gas & Electric Company. The district includes 30 blocks of the business and residential section. The present plans call for eight lights of 250 watts per light. It is expected that the district will soon be enlarged.

PORTLAND, ORE.—A city election will be held in Portland on June 4 to vote on an issue of $1,777,000 in 22-year 5 per cent serial bonds to be used in constructing the proposed municipal street lighting plant. The plan as outlined is to construct from water revenue a dam at Bull Run lake to increase the amount of water in the lake. From the $1,777,000 power plant bond issue an intake would be constructed to a flume 13½ miles above the Bull Run headworks

and a flume 13.2 miles long on the north side of the river to the reservoir would take care of the Bull Run headworks.

ESCONDIDO, CAL.—Arrangements have been completed for a transfer of the electric light and gas plant of the Escondido Utilities Company to the San Diego Consolidated Gas & Electric Company.

SAN MATEO, CAL.—The street lighting committee of the San Mateo Chamber of Commerce has formulated plans for the lighting of San Mateo's business district. It is proposed to improve the lighting on the following streets: B street from Fourth avenue to Baldwin avenue; Baldwin avenue to Ellsworth; Second avenue from the library to the Southern Pacific depot; Main street from Second avenue to Third avenue. This plan contemplates the installation of 47 single globe electroliers, each containing high power Mazda type "C" lamps.

PORTLAND, ORE.—The city council recently unanimously agreed to submit to the voters at the city election June 4 the measure proposed by City Commissioner Daly for a bond issue of $1,777,000 for the construction of a municipal lighting plant. The council in assuring Mr. Daly the measure would get a place on the ballot expressed the opinion that the bond involved should be raised in case figures to be compiled by J. L. Stannard show that the $1,777,000 would be insufficient. Hydroelectric engineers have estimated that Mr. Daly's figures are about $1,000,000 short of being sufficient to install the type of lighting plant he is proposing.

## TRANSMISSION

INDEX, WASH.—This town has voted $10,000 in bonds for a municipal power plant.

LOS ANGELES, CAL.—The Pacific Light & Power Company will move its substation in South Pasadena to West Alhambra.

OROVILLE, CAL.—The Great Western Power Company is now beginning work upon the extension of its power lines along the north fork to the Engels mine in Plumas County.

BOISE, IDAHO.—Permission is given the Washington Water Power Company to construct a transmission line near Wallace in an order handed down by the public utilities commission.

ALAMEDA, CAL.—The Union Iron Works has been granted permission by the Alameda City Council to purchase electricity from an outside concern under the control of the council and board of electricity.

LOS ANGELES, CAL.—Application has been made by the Pacific Light & Power Corporation to Major Pillsbury, U. S. engineer, for permission to install and maintain three high-power electric wires across Newport Bay.

SAN FRANCISCO, CAL.—Bids are being received by the Board of Works for furnishing and delivering electric line transformers for the Lower Cherry River power development, contract No. 24, Hetch Hetchy Water Supply.

ROSEBURG, ORE.—At a meeting of the Roseburg School Board, J. C. English & Company of Portland, were awarded the contract to furnish and install the electrical fixtures and glassware in the new high school building for $750.

VALLEJO, CAL.—Bids will be received until April 2 for a franchise for which the Vallejo Electric Light & Power Company has applied, to construct towers, piers, poles, and suspend wires, cables, etc., for transmitting electricity.

GALLUP, N. M.—George A. Keepers has been granted the right to furnish electricity for power, heat and illuminating purposes to the citizens of Gallup, by constructing and maintaining for a period of 25 years an electric power plant for the manufacture of electricity.

SALEM, ORE.—The state may acquire a power site on North Mill Creek and make its own power for the capitol and state institutions, according to a discussion at the meeting of the board of control. The contracts for electric current will expire July 1, 1918.

AUSTIN, NEV.—The Kingston mine will be the scene of active mining operations this summer. I. M. Hirschfield, of San Francisco has about concluded the details of a lease and bond agreement. The first work will be the installation of a hydroelectric plant, using the old mill for the power building which will develop 600 kilowatt power.

RIVERSIDE, CAL.—Work is to start immediately putting electric light and telephone wires underground, which will permit of the removal of poles from Seventh street, between Orange and Lemon, and also on Lemon street between Sixth and Seventh streets. Poles will soon be removed from Eighth street from Market to Pepper.

FRESNO, CAL.—Construction work is progressing on the San Joaquin Light & Power Corporation's power house No. 2 in Madera County district, 40 miles east of Fresno, and the building and the new machinery to be installed represent an expenditure of approximately $400,000. The hydroelectric plant, when completed, will deliver 5000 horsepower of electric energy to the high tension wires of the power company.

GALLUP, N. M.—Geo. A. Keepers has presented an application to the town board for a franchise to operate an electric plant and to construct a pole and lines system for the purpose of conveying electricity for light and power to all parts of the city. Mr. Keepers states that if the franchise is granted the plant will be in operation before the first of June, 1917. In the neighborhood of $75,000 will be invested.

CHICO, CAL.—C. M. Burleson, a civil engineer of San Francisco, has submitted a plan for the formation of a public utilities district in Chico and vicinity. It is proposed to form a lighting district, construct the plant, ditches and other parts of the system, and maintain same for a period of 25 years, at the end of this time the district is to revert to the city, without cost. The profits from the plant previous to its becoming a municipal utility would go to persons erecting and maintaining it.

RENO, NEV.—An electric generating plant, developing 2500 horspower will be constructed a short distance below Vista on the Truckee River as soon as weather permits, according to plans that have been perfected by the Nevada Valleys Power Company, which is now supplying current to Lovelock, Rochester, Fallon, Hazen and a number of mining camps. Preliminary work on its hydraulic system has already been commenced and it is expected to have the station in operation during the current year.

KLAMATH FALLS, ORE.—The California-Oregon Power Company will put on a force of 300 men just as soon as weather conditions will permit and rush to completion its big dam and power plant just across the state line at Copco, according to Manager G. Welton of this city. This new dam is being constructed across Wards Canyon, a rocky gorge of the Klamath River, 400 ft. wide. Water will be carried from the top of the dam to the power house in four steel pipes 12 ft. in diameter and will be capable of developing 50,000 h.p. The dam will crest a lake whose surface will be over 1000 acres.

MERCED, CAL.—Increasing use of electricity in farming is noted locally by numerous extensions of power lines and installations of pumping plant for farms of this vicinity reported by local manager Raleigh Casad of the San Joaquin Light & Power Corporation. The following have been announced: The construction of a power line from Atwater to Winter to serve the latter town; plans for the construction

of a power line to Irwin for irrigation plants; the construction of a power line to serve 7 pumping plants on the vineyard property of Ward B. Minturn in Yomato Colony; the installation of a line to the Robinson tract near Livingston for ten pumping plants for Arkalfan Brothers. Many small extensions and plans are being approved for numerous others.

OROVILLE, CAL.—A plan for co-operation whereby the cities of Sacramento, Oroville, Chico, Gridley, Biggs, Marysville, Lincoln and Roseville would erect a power plant to supply those cities with electric power has been outlined. The cost of the project is estimated at $3,000,000.

SAN DIEGO, CAL.—Edward Fletcher of San Diego has applied to the State Water Commission for an appropriation from Santa Ysabel Creek in San Diego County for the development of hydroelectric power. A dam 110 ft. high and 800 ft. long is planned. The cost of the project is given as $350,000.

BREMERTON, WASH.—Specifications have been received at the navy yard for a power plant at the Keyport station. The plant will cost about $30,000. Bids have been called for. The power plant will be used for torpedo testing as well as for furnishing the light and power for other purposes about the station.

## TRANSPORTATION

LOS ANGELES, CAL.—The Pacific Electric Railway Company will construct car inspection sheds at 800 Mission Road at a cost of $16,000.

ALPAUGH, CAL.—Bonds of the Alpaugh irrigation disfor the pipe and laying out about 600 acres of land for the extension of the irrigation system here.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been given a franchise for right-of-way on Eighth street, between Los Angeles street and Maple avenue.

GLOBE, ARIZ.—A temporary franchise has been granted by the city council to E. Sultan for an electric railroad on Broad street, a part of an interurban line that is planned to connect Globe and Miami.

SAN FRANCISCO, CAL.—Bids are being received by the board of public works for furnishing and delivering tie plates, rail braces, rail spikes, tie rods and auto creepers, being contract 91 Municipal Railway System.

TACOMA, WASH.—Immediate construction of the municipal street car line extension across the flats to the Lyleboe water way, occupied the attention of the council recently, following the passage of a bill at Olympia authorizing the work.

OAKLAND, CAL.—The San Francisco-Oakland Terminal Railways filed with L. W. Cummings, Oakland city clerk, application for a resettlement franchise to take the place of the many franchises granted under Oakland's former charter and which expire at different times.

MIAMI, ARIZ.—J. J. Mackay has filed a petition and request asking for permission and franchise to construct, maintain, extend, etc., under and upon public roads, streets, etc., in East Miami townsite and all additions thereto, water pipe lines, electric pole and wire lines, and other conduits for the transmission and distribution of water and electric current.

YUMA, ARIZ.—Application has been filed by the Yuma Light, Gas & Water Company for a franchise for the purpose of building an electric pole line from the city limits south along Orange avenue to the county road and thence westerly to the east bank of the East Main Canal for the purpose of supplying power for the operation of a pumping plant.

EL CENTRO, CAL.—A contract agreement has been filed whereby E. F. Sanguinetti of Yuma is to construct a 55,000-volt transmission line between the Holton power plant at Holtville and Hanlon Heading. In connection with the power line telegraph and telephone lines will be run across the sandhills to the Colorado River. The distance to be covered by the line is 43.5 miles.

TACOMA, WASH.—The Wheeler-Osgood Company soon will begin the construction of a new power plant on the tide lands at the cost of between $30,000 to $40,000. A permit for the construction of a stack 150 ft. high has been taken out. A battery of four boilers to furnish power for the dynamos will be installed and 1800 h.p. will be generated. The plant will be finished in 90 days.

QUINCY, CAL.—The State Water Commission has granted a permit to the Walker Mining Company of Salt Lake City to appropriate 20 cu. ft. per second of waters of Ward and Nye Creeks in Plumas County, for power purposes. The company's plans include building of a flume and pipe line 7692 ft. in length, and a power plant and transmission lines at a cost of approximately $25,000.

PORTLAND, ORE.—A petition of the Portland Railway, Light & Power Company to construct a broad gauge track on Yamhill street between First and Second streets, was denied by the council. The reason for refusing the grant is because the cars would interfere with the Carroll public market. The council expressed a willingness to grant the permit for a loop on Taylor street.

MODESTO, CAL.—The $465,000 bond issue of the Waterford Irrigation District has been validated at Sacramento. The bonds will now be signed by the president and secretary of the district, and by State Controller John S. Chamber and will be delivered promptly to the purchasers. The entire issue was sold by the district at bids of 97.1 several weeks ago, but validation was held up by the state pending further investigations by the state.

SAN FRANCISCO, CAL.—A project to irrigate 10,000 acres in Lassen County, with a total investment of $300,000, is disclosed in an application filed with the State Water Commission. The application is in the name of Benjamin J. Bennett of Salt Lake City and asks for the appropriation of 20,000 acre feet of water a year from Baxter Creek in Lassen County. The Sutter Basin Company of Sacramento also has filed an application for an appropriation of water to irrigate 8033 acres in that county. The company asks for 45 cubic feet per second from the Sacramento River. The work will cost approximately $20,000.

LOS ANGELES, CAL.—The board of supervisors has granted a franchise to the Pacific Electric Railroad Company to construct and for a period of 40 years to maintain an electric street railroad along certain public roads and highways of Los Angeles County, consisting of a standard gauge single and double track spur, over and across Covina boulevard, along Railroad avenue and over and along Clark street and Los Angeles street, single track spur over and across Covina boulevard and along Railroad avenue from the north right-of-way of the Pacific Electric Company, Covina line to Alderson avenue, double track spur over and across Clark street to the S. P. R. R. Company's right-of-way, single track spur over and across Los Angeles street.

## TELEPHONE AND TELEGRAPH

SANTA ANA, CAL.—A building is soon to be erected by the Pacific Telphone Company on the corner of East Fifth and Bush streets.

BOWIE, ARIZ.—The Mountain States Telephone & Telegraph Company has purchased the entire interest of the local phone system and is modernizing the entire plant.

AUBURN, CAL.—People of the Gold Hill district are to improve their telephone service. It was decided at a meeting

that they will unite with the people of the Mount Pleasant District in building a new pole line from the Mulligan place to Lincoln.

ARCADIA, CAL.—Bids will be received by the trustees up to April 4th, for installing 29 reinforced concrete ornamental street lighting standards together with wires, pipes, conduits, globes, lamps and all necessary fixtures thereto on portion of First avenue.

GARFIELD, WASH.—At a meeting of the trustees of the Garfield and Rural Telephone Company, it was decided to accept the offer of W. M. Anderson to take over the system by the first of April and give connection with the long distance toll lines out of Garfield.

YUMA, ARIZ.—E. M. Burgess, vice-president and general manager of the Mountain States Telephone & Telegraph Company has been here looking over the ground relative to approving plans for an exchange at Sonerton, which would cover the entire two valleys and surrounding country. The plans contemplate an expenditure of $25,000.

SEWARD, ALASKA.—Linemen on snowshoes have just completed laying the telephone and telegraph line for the government railroad across a section of swamp in Susitna Valley, which is impassable in summer; and have opened communication from Seward to the Talkeetna River, 245 miles out, or over half way to Fairbanks. The northern end of the line is now located at camp "Dead Horse Hill."

## IRRIGATION

SACRAMENTO, CAL.—The board of supervisors has approved plans for the formation of Fairoaks irrigation district.

PHOENIX, ARIZ.—Plans are now being drawn by the state board of control for an irrigation system for the capitol grounds.

SUSANVILLE, CAL.—At the election held here recently to determine whether Baxter Creek irrigation district should be formed, the result was in favor of the proposition.

SUSANVILLE, CAL.—Surveyors of the Honey Lake Mutual Water Users' Association have commenced surveys to determine the cost of bringing water from their project into Johnstonville district.

ARBUCKLE, CAL.—The chamber of commerce has instructed its secretary to correspond with Secretary Beard of the Sacramento Valley Development Association, Senator Purkitt and Assemblyman Polsey regarding needed irrigation of this section.

ROSEVILLE, CAL.—Western Placer County may have water for irrigation any time it is ready to receive it. Maps and plans of the entire distribution of water brought down from the hills by the Pacific Gas & Electric Company, have been completed.

FORT JONES, CAL.—At a meeting of property owners from the east side of the valley preliminary steps were taken for the formation of an irrigation district of approximately 6000 acres. It is designed to hold an election for the purpose in the near future.

HANFORD, CAL.—Gifford, Ascelano Olive Company has let the contract to the Adell-Cortright Concrete Pipe Company for the installation of 2½ miles of concrete pipe for irrigation purposes, which will cover the entire Gifford tract south of Huron.

SAN BERNARDINO, CAL.—The petition of the Mojave River irrigation district has been declared by the supervisors to be sufficient and the $2,500,000 water project of Victor Valley has been started.

OAKDALE, CAL.—Two storage propositions for the Oakdale and South San Joaquin irrigation districts were broached at a joint meeting of the two districts boards held here. The proposal of J. H. Cameron of San Francisco for building a dam capable of storing 80,000 acre feet of water was discussed at some length, but no action was taken.

HOLLISTER, CAL.—Despite the fact that this year's water supply is only half what it was a year ago at this time, Manager Paul F. Brown of the San Benito Land & Water Company, announces at this time the water was turned into the company ditches for the first time this year, that the supply will be ample providing no waste takes place.

SAN FRANCISCO, CAL.—Consulting Engineer Stephen E. Kieffer, Mechanics' Institute Building, states that plans will be completed and bids called for about the middle or last of April for approximately $280,000 worth of construction in Paradise irrigation district of Butte County. Included in this work is a hydraulic fill earth dam and about 30 miles of main pipe lines. Bids will be taken for both steel riveted and wood stave pipe in dimensions of from 3 in. to 36 in.

KLAMATH FALS, ORE.—The Keno irrigation canal has been leased by the government to the California-Oregon Power Company for a period of 10 years at a cost of $1000 a year. The contract was signed by Secretary of the Interior Franklin K. Lane and Alex J. Rosborough, vice-president of the power company. The contract provides that a dam may be erected by the power company within two years, if it so desires. Such a dam if constructed must furnish power for drainage and pumping requirements of the Klamath project at the rate of seven mills per kilowatt hour.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